

Vetal 5

Veterinary Multi-Parameter Monitor

Operator's Manual



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- the product is used in accordance with the instructions for use.

WARNING

- **This equipment must be operated by skilled/trained clinical professionals.**
 - **It is important for the hospital or organization that employs this equipment to carry out a reasonable service/maintenance plan. Neglect of this may result in machine breakdown or personal injury.**
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Preface

Manual Purpose

This manual contains the instructions necessary to operate the product safely and in accordance with its function and intended use. Observance of this manual is a prerequisite for proper product performance and correct operation and ensures animal and operator safety.

This manual is based on the maximum configuration and therefore some contents may not apply to your product. If you have any question, please contact us.

This manual is an integral part of the product. It should always be kept close to the equipment so that it can be obtained conveniently when needed.

Intended Audience

This manual is geared for clinical professionals who are expected to have a working knowledge of medical procedures, practices and terminology as required for monitoring of critically ill animals.

Illustrations

All illustrations in this manual serve as examples only. They may not necessarily reflect the setup or data displayed on your monitor.

Conventions

- *Italic text* is used in this manual to quote the referenced manuals, chapters, sections and formulas.
- **Bold text** is used to indicate the screen texts and names of hard keys.
- → is used to indicate operational procedures.

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1 Safety

1.1 Safety Information

WARNING

- Indicates a potential hazard or unsafe practice that, if not avoided, could result in death or serious injury.
-

CAUTION

- Indicates a potential hazard or unsafe practice that, if not avoided, could result in minor personal injury or product/property damage.
-

NOTE

- Provides application tips or other useful information to ensure that you get the most from your product.
-

1.1.1 Warnings

WARNING

- This equipment is used for single animal at a time.
- To avoid explosion hazard, do not use the equipment in the presence of oxygen-rich atmospheres, flammable anesthetics, or other flammable agents.
- Use and store the equipment in specified environmental condition. The monitor and accessories may not meet the performance specification due to aging, stored or used outside the specified temperature and humidity range.
- The equipment is not intended to be used within the Magnetic Resonance (MR) environment.
- Before putting the system into operation, the operator must verify that the equipment, connecting cables and accessories are in correct working order and operating condition.
- To avoid risk of electric shock, the equipment must only be connected to mains power with protective earth. If a protective earth conductor is not provided, operate it on battery power, if possible.
- Do not use the multiple portable socket outlets (MPSO) or AC mains extension cords. Insure that the sum of the individual ground leakage currents does not exceed the allowable limits.
- Do not touch the animal and live parts simultaneously. Otherwise animal injury may result.
- Do not come into contact with the animal during defibrillation. Otherwise serious injury or death could result.
- Do not open the equipment housings. All servicing and future upgrades must be carried out by trained and authorized personnel.
- Do not exclusively rely on audible alarms for animal monitoring. Adjusting alarm volume to a low level or turning off alarm sound may result in animal hazards.
- Customize alarm settings according to animal situations and keep animals under close surveillance.
- Do not place the equipment or accessories in any position that might cause it to fall on the animal.
- Do not start or operate the equipment unless the setup was verified to be correct.
- To avoid inadvertent disconnection, route all cables in a way to prevent a stumbling hazard. Wrap and secure excess cabling to reduce risk of entanglement by animals or personnel.

- If any measurement seems questionable, first check the animal's vital signs by alternate means and then check the equipment for proper functioning.
 - Physiological data and alarm messages provided by the monitor should not be used as the only basis for diagnosis or therapy decisions. They must be used in conjunction with clinical signs and symptoms. Misinterpreting measured values or other parameters may result in animal hazards.
 - The software equipment copyright is solely owned by Mindray Animal Medical. No organization or individual shall resort to modifying, copying, or exchanging it or to any other infringement on it in any form or by any means without due permission.
-

1.1.2 Cautions

CAUTION

- Use only parts and accessories specified in this manual.
 - Ensure that the equipment is supplied with continuous electric power during work. Sudden power failure may cause data loss.
 - Magnetic and electrical fields are capable of interfering with the proper performance of the equipment. For this reason make sure that all external devices operated in the vicinity of the equipment comply with the relevant EMC requirements. Mobile phone, X-ray equipment or MRI devices are a possible source of interference as they may emit higher levels of electromagnetic radiation.
 - Always install or carry the equipment properly to avoid damage caused by drop, impact, strong vibration or other mechanical force.
 - Dry the equipment immediately in case of rain or water spray.
 - Some settings are password protected and can only be changed by authorized personnel.
 - Do not loop the animal cabling into a tight coil or wrap around the device, as this can damage the animal cabling.
 - Dispose of the package material as per the applicable waste control regulations. Keep it out of children's reach.
 - At the end of its service life, the equipment, as well as its accessories, must be disposed of in compliance with the guidelines regulating the disposal of such products. If you have any questions concerning disposal of the equipment, please contact the Customer Service Department or your local distributor.
-

1.1.3 Notes

NOTE

- The equipment uses a mains plug as isolation means to the mains power. Do not locate the equipment in a place difficult to operate the mains plug.
 - In normal use, the operator is expected to be in front of the equipment.
 - The software is developed in compliance with IEC 62304.
 - This manual includes information related to all features of the monitor. Some features may not be available on your monitor.
 - Keep this manual in the vicinity of the equipment so that it can be obtained conveniently when needed.
-

1.2 Equipment Symbols

Symbol	Description	Symbol	Description
	General warning sign		Refer to instruction manual/booklet
	Serial number		Temperature limitations
	Date of manufacture		Manufacturer
	USB connector		Graphical record
	Battery indicator		Computer network
	Equipotentiality		Alternating current
	DEFIBRILLATION-PROOF TYPE CF APPLIED PART		DEFIBRILLATION-PROOF TYPE BF APPLIED PART
	NIBP start/stop		Calibration
	Stand-by		Menu
IPX1	Protected against vertically falling water drops		Non-ionizing electromagnetic radiation
	Alarm pause		Alarm reset
	Gas outlet		Output
	Video output		Defibrillation synchronization output
	Humidity limitations		Atmospheric pressure limitations

Symbol	Description	Symbol	Description
	Stacking limit by number		Keep dry
	This way up		Fragile; handle with care
	CE marking		The following definition of the WEEE label applies to EU member states only: the use of this symbol indicates that waste electrical and electronic equipment must not be disposed of as unsorted municipal waste and must be collected separately. By ensuring that this product is disposed of correctly, you will help prevent bringing potential negative consequences to the environment and human health. For more detailed information with regard to returning and recycling this product, consult the distributor from whom you purchased the product.

The general meaning assigned to geometric shapes, safety colors and contrast colors for safety signs are as follows:

Geometric shape	Meaning	Safety color	Contrast color	Graphical symbol color
	Prohibition	Red	White	Black
	Mandatory action	Blue	White	White
	Warning	Yellow	Black	Black

2 Equipment Introduction

2.1 Intended Use

The Veterinary Multi-Parameter Monitor, hereafter called the monitor, is intended to be used for monitoring, displaying, reviewing, storing, alarming and transferring of multiple physiological parameters including ECG (arrhythmia detection, ST segment analysis, QT/QTc monitoring, and heart rate (HR), respiration (Resp), temperature (Temp), pulse oxygen saturation (SpO₂), pulse rate (PR), non-invasive blood pressure (NIBP), invasive blood pressure (IBP) (including PPV), cardiac output (C.O.), and carbon dioxide (CO₂).

The monitor is to be used in animal hospitals by clinical professionals or under their guidance. They should only be used by persons who have received adequate training in their use.

2.2 Contra-indications

Not identified yet

2.3 Applied Parts

The applied parts of the monitor are:

- ECG electrode and leadwire
- SpO₂ sensor
- Temp probe
- NIBP cuff
- IBP transducer
- C.O. sensor
- CO₂ sampling line, and water trap

2.4 System Components

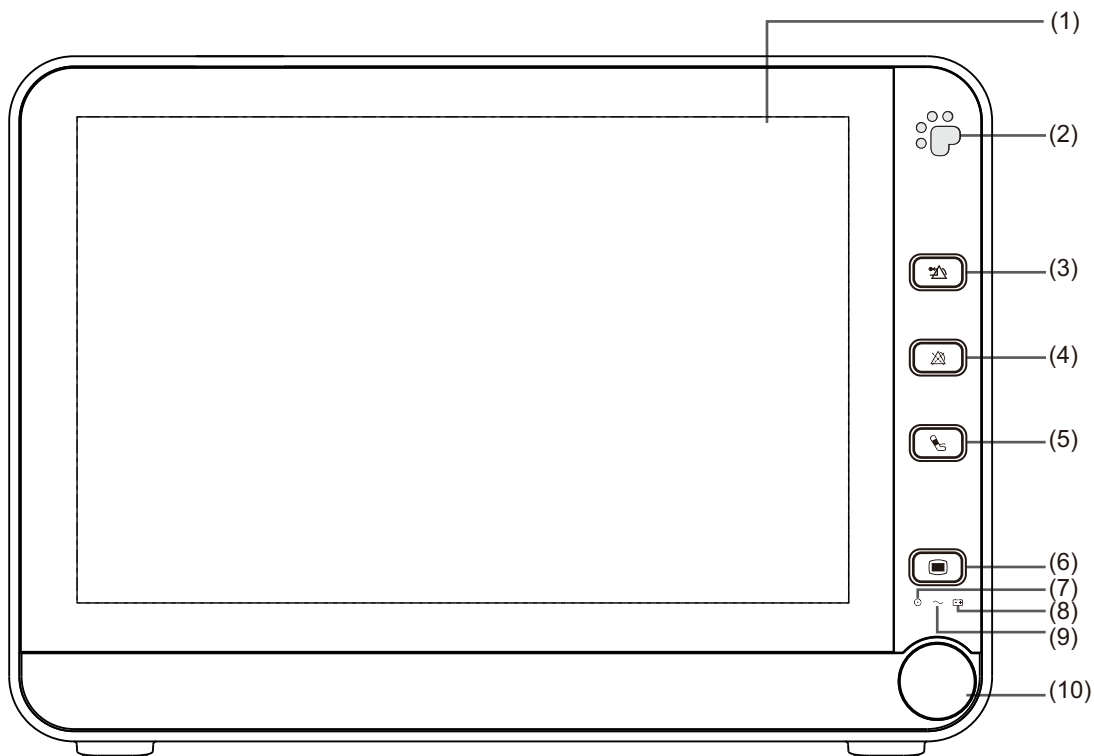
The monitor consists of the main unit, display, input devices, and output devices.

NOTE

- **Your monitor may not include all these components. Contact the Customer Service Department or your local distributor for the available components.**
-

2.4.1 Main Unit

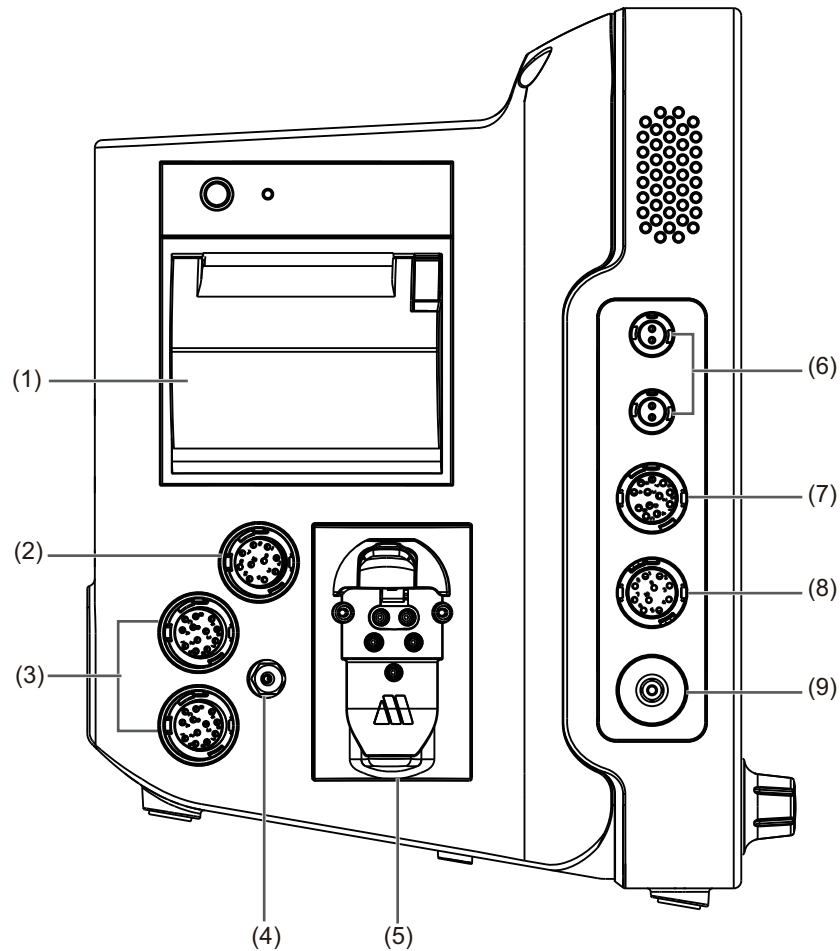
2.4.1.1 Front View



- (1) Display
- (2) Alarm lamp
When a physiological alarm or technical alarm occurs, this lamp lights and flashes corresponding with the alarm priority:
 - High priority alarms: the lamp quickly flashes red.
 - Medium priority alarms: the lamp slowly flashes yellow.
 - Low priority alarms: the lamp lights in yellow without flashing.
- (3) Alarm Reset hard key
Press to reset the alarm system.
- (4) Alarm Pause hard key
Press to pause the physiological alarm system.
- (5) NIBP Start/Stop hard key
Press to start an NIBP measurement or stop the current NIBP measurement.
- (6) Main Menu hard key
Press it to enter the main menu or press it to close that menu.
- (7) Power indicator
 - On: when the monitor is turned on.
 - Off: when the power is turned off.
- (8) Battery indicator
 - Green: the battery is fully charged or being charged.
 - Flashing green: the monitor operates by battery power.
 - Off: no battery is installed, or the battery is malfunctioning, or the monitor is powered off and no power is connected.

- (9) AC Power indicator
- On: when the AC power is connected.
 - Off: when the AC power is not connected.
- (10) Knob
- Rotate the Knob clockwise or anti-clockwise. With each click, the highlight jumps to the neighboring item. When you reach your desired item, press the Knob to select it.

2.4.1.2 Left View



(1) Recorder

(3) IBP cable connector

(5) CO₂ water trap seat

(7) SpO₂ probe connector

(9) NIBP cuff connector

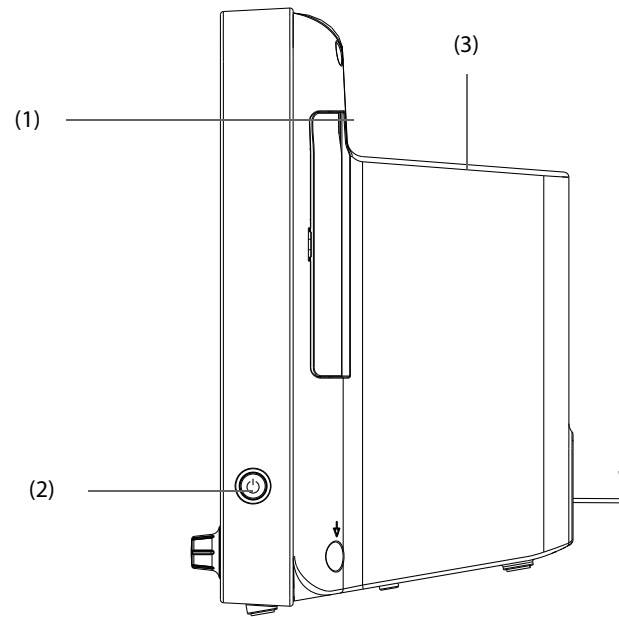
(2) C.O. cable connector

(4) CO₂ Gas outlet

(6) Temperature probe connector

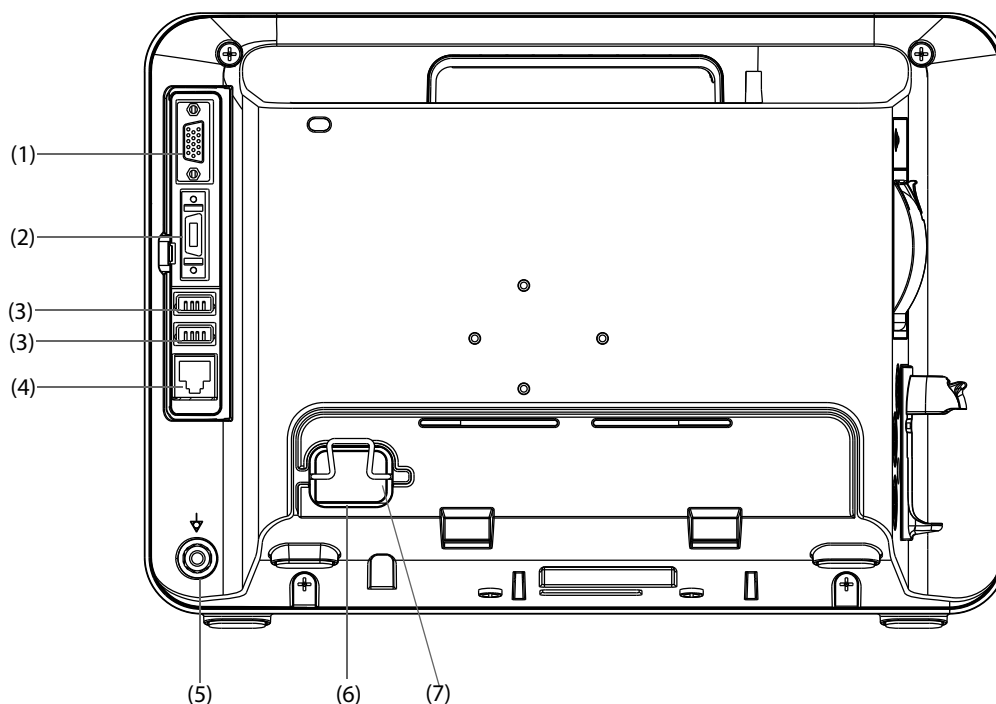
(8) ECG cable connector

2.4.1.3 Right View



- (1) Handle
- (2) Power switch
 - Pressing this switch turns on the monitor.
 - When the monitor is on, pressing and holding this switch for 3 seconds to turn off the monitor.
- (3) Storage space: it is used to store cables etc.

2.4.1.4 Rear View



- (1) VGA connector
It connects an external display, which extends the display capability of your monitor. The contents displayed on the external display screen accords with those displayed on the monitor screen.
- (2) Multifunctional connector (optional)
It outputs defibrillator synchronization signals and analogy output signals.
- (3) USB connectors
It connects USB devices, for example the barcode reader.
- (4) Network connector
It is a standard RJ45 connector which connects the monitor to the central monitoring system (CMS) or other network devices.
- (5) Equipotential grounding terminal
When using the monitor together with other devices, connect their equipotential grounding terminals together to eliminate the potential difference between them.
- (6) AC power input
- (7) Power mousing- hook

2.4.2 Input Devices

The monitor allows data entry through touchscreen, hardkey and barcode reader.

You can only use Mindray Animal Medical specified input devices.

2.4.3 Printing Devices

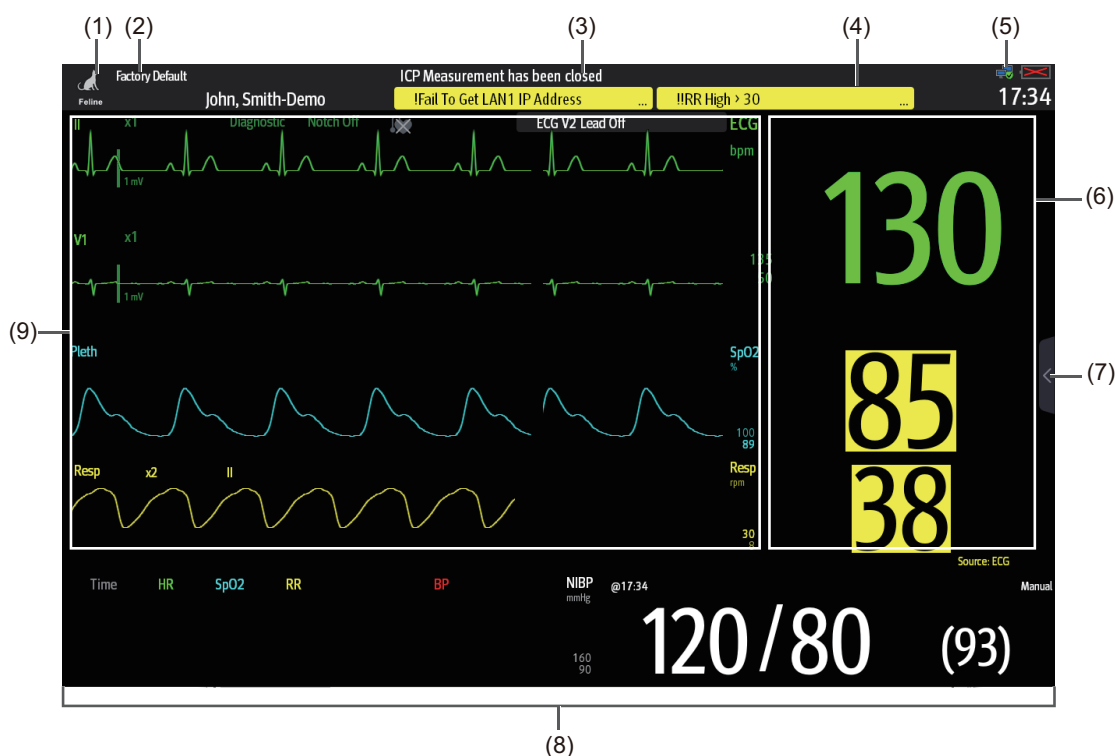
You can use Mindray Animal Medical specified printer and/or recorder to output animal information and data.

The monitor is configured with a build-in recorder.

The printer can be connected to the monitor through the network to output reports.

2.5 Screen Display

The following figure shows the normal screen:



2.6 Available Quick Keys

The following table shows available quick keys.

Symbol	Label	Function	Symbol	Label	Function
	Main Menu	Enters the main menu.		Standby	Enters the Standby mode.

Symbol	Label	Function	Symbol	Label	Function
	Alarm Setup	Enters the Alarm Setup menu.		Alarm Reset	Resets the alarm system.
	End Case Report	Prints the selected end case reports.		Alarm Pause	Pauses the physiological alarms.
	Review	Enters the Review menu.		Call Help	Calls for help.
	Patient Demographics	Enters the Patient Demographics menu.		Screen Setup	Enters the Screen Setup menu.
	NIBP Start/Stop	Starts an NIBP measurement or stops the current NIBP measurement.		NIBP Stop All	Stops all NIBP measurements.
	NIBP STAT	Starts a five-minutes continuous NIBP measurement.		NIBP Measure	Enters the NIBP Measure menu.
	Zero IBP	Starts IBP zero calibration.		Venipuncture	Inflates the NIBP cuff to help venous puncture.
	PAWP	Enters the PAWP screen.		C.O. Measure	Opens the C.O. Measure window.
	Parameters Setup	Enters the Parameters Setup menu.		Minitrends	Enters the Minitrends screen.
	Manual Event	Manually triggers and saves an event.		Night Mode	Enters the night mode.
	ECG Full-Screen	Enters the ECG full screen.		Intubation Mode	Enters the intubation mode.
	CPB Mode	Enters the CPB mode.		Freeze	Freezes waveforms.
	Volume and Brightness	Enters the Volume and Brightness menu.		Load Config	Enters the Load Config menu.
	Calculations	Enters the Calculations menu.		Record	Starts/Stops a recording.
	Print	Starts printing a real-time report.		ECG Lead/Gain	Enters the ECG Lead/Gain menu.
	ECG 24h Sum	Views the 24-hour ECG summary.		Discharged Patients	Enters the Discharged Patients dialog box.
	Discharge Patient	Enters the Discharge Patient dialog box.		Stages of Anesthesia	Enters the Stages of Anesthesia menu.
	ECG Library	Enters the ECG Library menu.		CO2 Library	Enters the CO2 Library menu.

2.7 On-screen Symbols

The following table lists the on-screen symbols displayed on the system status information area:

Symbol	Description	Symbol	Description
	Canine		Feline
	Other animal		All the alarms are paused.
	The alarm system is reset.		Individual physiological alarms are turned off or the monitor is in the alarm off status.
	Audible alarm tones are paused.		Audible alarm tones are turned off
	The battery works correctly. The green portion represents the remaining charge.		The battery is being charged.
	The battery has low power and needs to be charged.		The battery has critically low charge and needs to be charged immediately. Otherwise, the monitor will soon automatically shut down.
	No battery is installed.		Wired network is connected.
	Wired network is not connected.		Wireless network is connected. The solid part indicates network signal strength.
	Wireless network is not connected.		Wireless network is disabled.

3 Preparations

3.1 Safety Information

WARNING

- Use only installation accessories specified by Mindray Animal Medical.
 - The software copyright of the equipment is solely owned by Mindray Animal Medical. No organization or individual shall resort to altering, copying, or exchanging it or to any other infringement on it in any form or by any means without due permission.
 - Devices connected to this equipment must meet the requirements of the IEC standards (e.g. IEC 62368-1 safety standards for information technology equipment and IEC 60601-1 safety standards for medical electrical equipment). The configurations of the devices must meet the requirements of the IEC 60601-1 medical electrical systems standard. Any personnel who connect devices to this equipment's signal input/output port is responsible for providing evidence that the safety certification of the devices has been performed in accordance to the IEC 60601-1. If you have any questions, contact the Customer Service Department or your local distributor.
 - The monitor and parameter monitoring accessories are suitable for use within the animal environment. For other equipment and accessories connected to the monitor, consult corresponding manufacturers for the suitability within the animal environment.
 - If it is not evident from the equipment specifications whether a particular combination with other devices is hazardous, for example, due to summation of leakage currents, please consult an expert in the field, the Customer Service Department or your local distributor. A determination must be made that the proposed combination will not negatively affect the devices themselves or the animal's safety.
 - If the accuracy of any value displayed on the monitor, CMS system, or printed on a graph strip or report is questionable, determine the animal's vital signs by alternative means. Verify that all equipment is working correctly.
-

CAUTION

- The monitor should be installed by Mindray Animal Medical authorized personnel.
 - Keep the packaging material out of children's reach. When disposing of the packaging material, be sure to observe the applicable waste control regulations and keep it out of children's reach.
 - The monitor may be subject to microbacteria contamination during storage, transport, or use. Prior to use, please verify that the packages are intact, especially the packages of single use accessories. In case of any damage, do not apply it to animals.
 - Make sure that the monitor operating environment meets the specific requirements. Otherwise, unexpected consequences, e.g. damage to the monitor, could result.
 - Observance of this manual is a prerequisite for proper performance and correct operation, and ensure animal and operator safety.
-

NOTE

- Install the monitor in a place that facilitates observation, operation, and maintenance. The intended location for the monitor is where users can touch with hands.
 - Save the packing case and packaging material as they can be used if the equipment must be reshipped.
-

3.2 Installation

3.2.1 Environmental Requirements

The operating environment of the monitor must meet the requirements specified in this manual.

The environment should be reasonably free from noises, vibration, dust, corrosive, flammable and explosive substances. If is installed in a cabinet, sufficient space in front and behind should be left for convenient operation, maintenance and repair. To maintain good ventilation, the equipment should be at least 5 cm away from around and the cabinet.

When the equipment is moved from one place to another, condensation may occur as a result of temperature or humidity difference. In this case, never start the system before the condensation disappears.

3.2.2 Monitor Installation

The monitor can be installed in various ways as required.

- Wall mount
- Placed on desk
- Trolley tray
- Bedrail hook
- Bedrail clamp

3.3 Connecting the Power Supply

3.3.1 Connecting the AC Power Supply

WARNING

- **Always use the accompanying power cord delivered with the monitor.**
 - **Before connecting the monitor to the AC mains, check that the voltage and frequency ratings of the power line are the same as those indicated beside the AC power input.**
 - **Use the cable retainer to secure the power cord to prevent it from falling off.**
 - **Use the battery if the integrity of the protective earth conductor or the protective earthing system in the installation is in doubt.**
-

The monitor is powered by AC power supply. Before connecting the equipment to the AC mains, check that the voltage and frequency ratings of the power line are the same as those indicated besides the AC power input.

To use the AC power source, follow this procedure:

1. Connect the female end of the power cord with the AC power input of the equipment.
2. Connect the male end of the power cord with a wall AC outlet.
3. Check that the power indicator is on.

The AC power indicator is off if the AC mains is not connected. When AC indicator is illuminated in green.

3.3.2 Using the Battery

This monitor is designed to operate battery power when the external power supply is not available. The monitor uses mains power as primary power source. In case of mains power failure, the monitor automatically runs on the battery power.

WARNING

- **Keep the batteries out of children's reach.**
- **Use only specified battery. Use of a different battery may present a risk of fire or explosion.**

- **Keep the batteries in their original package until you are ready to use them.**
- **Do not allow the battery to come into contact with liquid.**
- **Do not crush, drop or puncture the battery. Mechanical abuse can lead to internal damage and internal short circuits. If a battery has been dropped or banged against a hard surface, whether damage is externally visible or not, remove the battery from use and dispose of it properly.**
- **If a battery shows signs of damage or signs of leakage, replace it immediately.**
- **The battery should be charged only in this monitor.**
- **Extremely high ambient temperature may cause battery overheat protection, resulting in monitor shutdown.**
- **The lithium-ion battery has a service life of three years. Replace your battery when it reaches the end of its service life. Failure to replace the battery may cause serious damage to your monitor from battery overheating.**
- **Do not incinerate batteries or expose them to temperatures above 60°C This may cause the battery to burn, explode, leak, or become hot, causing personal injury.**

CAUTION

- **Remove the battery before shipping the monitor or if it will not be used for an extended period of time.**
-

NOTE

- **If the power input fails and the monitor runs on the battery power, the display brightness automatically lowers to the dimmest. You can manually adjust the display brightness as required.**
 - **When the battery is low, the monitor presents the Low Battery alarm; If the battery is almost depleted, the monitor presents the Critically Low Battery alarm. In this case, immediately connect the AC mains to power the monitor and charge the battery. Otherwise, the monitor will automatically shut down soon.**
-

3.3.2.1 Conditioning the Battery

The performance of batteries deteriorates over time. You should condition the batteries every 3 months. If the battery is not conditioned for a prolonged time, its charge indication may not be accurate and you may wrongly evaluate the remaining battery runtime.

To condition a battery, follow this procedure:

1. Disconnect the monitor from the animal and stop all monitoring and measuring procedures.
2. Turn off the monitor, and connect the monitor to the external power supply. Allow the battery to be charged uninterruptedly till it is fully charged.
3. Disconnect the monitor from the external power supply, and turn on the monitor. Allow the monitor to run on the battery until the battery is completely depleted and the monitor automatically shuts down.
4. Connect the monitor to the external power supply again and fully charge the battery again for use or charge it to 40 – 60% for storage.

NOTE

- **Do not use the monitor to monitor the animal during battery conditioning.**
 - **Do not keep the battery fully charged without routine conditioning; otherwise, the aging process will be accelerated.**
 - **Do not interrupt battery conditioning.**
-

3.3.2.2 Checking Battery Performance

The performance of a rechargeable battery deteriorates over time. You should check the battery performance every 3 months or if you doubt that the battery may fail.

See steps 1 to 3 of *Conditioning the Battery* to check battery performance. The operating time of the battery reflects their performance directly. If the operating time of a battery is noticeably shorter than that stated in the

specifications, the battery may reach its service life or malfunction. If the battery performance meets the requirement, fully charge the battery again for use or charge it to 40 – 60% for storage.

NOTE

- **Battery operating time depends on equipment configuration and operation. For example, high display brightness or measuring NIBP repeatedly will shorten the battery operating time.**
-

3.3.2.3 Storing the Batteries

When storing batteries, make sure that the battery terminals do not come into contact with metal objects. If batteries are stored for an extended period of time, place the batteries in a cool place.

Condition the stored batteries every 3 months.

NOTE

- **Remove the battery from the equipment if the equipment is not used for a prolonged time (for example, several weeks). Otherwise the battery may over discharge.**
 - **Storing batteries at high temperatures for an extended period of time will significantly shorten their life expectancy.**
 - **The battery storage temperature is between -5 °C and 35 °C. Storing batteries in a cool place can slow the aging process. Ideally the batteries should be stored at 15 °C.**
-

3.3.2.4 Recycling Batteries

Discard a battery in the following situations:

- The battery has visual signs of damage.
- The battery fails.
- The battery is aged and its runtime significantly less than the specification.
- The battery service life is reached.

Properly dispose of batteries according to local regulations.

3.4 Turning on the Monitor

Press the power switch on the right panel of the monitor.

When the monitor is turned on, the alarms are paused for two minutes. Then the alarm system is activated.

3.5 Turning Off the Monitor

Before turn off the monitor, perform the following check:

1. Ensure that the monitoring of the animal has been completed.
2. Disconnect the cables and sensors from the animal.
3. Make sure to save or clear the animal monitoring data as required.

To turn off the monitor, press and hold the power switch for 3 seconds. Turning off the monitor does not disconnect the monitor from the AC mains. To completely disconnect the power supply, unplug the power cord.

CAUTION

- **Press and hold the power switch for 10 seconds to forcibly shut down the monitor if it could not be shut down normally. This may cause loss of animal data.**
-

NOTE

- **If the power is restored within 30 minutes, monitoring will resume with all active settings unchanged; if the monitor is without power for more than 30 minutes, the monitor behaves the same as it is normally turned off.**
-

3.6 Standby

If the operator wants to stop monitoring an animal temporarily but does not want to turn off the monitor, standby mode can be used.

3.6.1 Entering the Standby Mode

To enter the standby mode, follow this procedure:

1. Select **Standby** quick key.
2. Select **OK**.

The monitor behaves as follows after entering the standby mode:

- Stops all parameter measurements.
- Disables all the alarms and prompt messages, except for the battery low alarm.
- Turns screen brightness to the dimmest after entering the standby mode for 30 seconds.

WARNING

- In the standby mode, the monitor stops all parameter measurements and disable all the alarm indications, except for the battery low alarm. Pay attention to the potential risk of placing the monitor to standby.
-

3.6.2 Exiting the Standby Mode

To exit the standby mode, choose any of the following ways:

- Select **Resume** monitor to exit the standby mode and resume monitoring the current animal.
- Select **Discharge Patient** to discharge the current animal.

When the monitor exists the standby mode, the alarms are paused for 2 minutes. Then the alarm system is activated.

3.7 Entering Training Mode

Training mode provides basic instructions about how to use this monitor. Users can enter training mode before actually using this device.

To enter training mode, follow this procedure:

1. Select the **Main Menu** hard key or quick key → from **System** column select **Training Mode**.
2. Select **OK** in the pop-up window and the system enters the **Training Mode** menu, automatically demonstrating learning content.
3. In the **Training Mode** menu, select **Next** to go to next learning content; select **Learn Later** to exit selflearning and return to animal monitoring; select **Previous** to go back to the previous learning content.
4. In **Connect Accessories** and **Monitoring Setup** steps, you need to swipe up and down on the screen to view complete learning content.
5. When “**Congratulation! You have acquired basic skill in operating this equipment**” appears, select Next to return to animal monitoring.

3.8 Starting Monitoring an Animal

After turning on the equipment, follow this procedure to monitor an animal:

1. Admit an animal.
2. Check animal settings. Make sure that alarm limits, species and paced status, and so on, are appropriate for your animal. Change them if necessary.
3. Starting monitoring. For more information, see corresponding measurement chapters.

3.9 Stopping a Parameter Measurement

To stop monitoring a parameter, follow this procedure:

1. Remove the corresponding sensor from the animal.
2. Disconnect the sensor from the animal cable.
3. Disconnect the cable from the parameter module.
4. If you are using the disposable sensor, discard it.

4 Basic Operations and Settings

4.1 Basic Operations

4.1.1 Using Keys

Using the Knob

You can use the knob to perform the following operations:

- Rotate: rotate the knob clockwise or anti-clockwise; with each click, the highlight jumps to the neighboring item.
- Press: when you reach your desired item, press the Knob to select it.

Using the On-Screen Keyboard

The on-screen keyboard enables you to enter information:

- Enter the information by selecting one character after another.
- Select the Backspace key  to delete single characters or select  to delete the entire entry.
- Select the Caps Lock key  to access uppercase letters.

Select the Enter key  to confirm the entry and close the on-screen keyboard.

4.1.2 Tapping or Swiping across the Screen

CAUTION

- Check that the touchscreen is not damaged or broken. If there is any sign of damage, stop using the monitor and contact the Customer Service Department or your local distributor.
 - If the touchscreen is loose, stop using the monitor and contact the Customer Service Department or your local distributor.
-

You can touch the screen or swipe across the screen with your fingers to operate the monitor.

- Tapping the screen
 - ◆ To select an item from menus or lists, tap on the item with your finger.
 - ◆ To enter a parameter menu, tap corresponding numeric area or waveform area. For example, select the ECG numeric area or waveform area to enter the ECG menu.
- Swiping across the screen with a single finger
 - ◆ To display the configured quick keys, swipe to the left  symbol.
 - ◆ To scroll through a list and a menu, swipe up and down.
 - ◆ To adjust the screen brightness, swipe up and down on the left part of the main screen.
 - ◆ To adjust the alarm volume, swipe up and down on the right part of the main screen.
 - ◆ To set wireless network, swipe down from the top.
- Swiping across the screen with two fingers
 - ◆ To switch to another screen, swipe from left to right or right to left across the screen to change the screen between the normal screen, minitrends screen and big numerics screen.
 - ◆ To discharge an animal, swipe from top to bottom.

4.1.3 Locking the Touchscreen

To avoid misuse, you can temporarily disable the touchscreen. To do so, hold and press the **Main Menu** quick key and slide as directed by the arrow. A padlock symbol  displays at the top of the main menu quick key if the

touchscreen is disabled. If you need to manually enable the touchscreen, tap any where on the screen and slide as directed by the arrow.

The touchscreen is enabled when the preset time is reached. If you need to manually enable the touchscreen, hold and press the Main Menu quick key and slide as directed by the arrow.

4.1.4 Using the On-Screen Timers

The monitor has a timer function to notify you when a preset time period is expired. You can simultaneously display up to 4 timers. You can set each timer separately. The timer will prompt after the set time.

4.1.4.1 Displaying Timers

To display a timer, follow this procedure:

1. Access **Tile Layout** in either of the following ways:
 - ◆ Select the **Screen Setup** quick key → select the **Tile Layout** tab.
 - ◆ Select the **Main Menu** hard key or quick key → from the **Screen Setup** column select **Tile Layout**.
2. Click the parameter area where you want to display the timer, and then select the timer.

4.1.4.2 Controlling the Timer

The timer provides the following controls:

- **Start:** starts the timer.
- **Pauses:** pauses the timer.
- **Resume:** resumes the timer.
- **Reset:** clears the timer and end this timer episode.

WARNING

- **Do not use the timers for tasks related to critical animals.**
-

4.1.4.3 Setting the Timer

You can set each timer independently. To set the timer, follow this procedure:

1. Select the timer area to enter the **Timer Setup** menu.
2. Set **Timer Type**:
 - ◆ **Normal:** the timer has a single and defined run time, and stops when the run time is reached.
 - ◆ **Advanced:** the timer has a single and defined run time. When the run time is reached, the timer continuously displays the time beyond the end of run time.
 - ◆ **Cycled:** the timer has a single and defined run time. When the run time is reached, the timer restarts automatically. The cycles is also displayed.
 - ◆ **Unlimited:** the timer displays the time elapsed since the timer was started.
 - ◆ **Clock:** the timer displays the system time.
3. Set **Direction**.
4. Set **Run Time**.
5. Set **Reminder Volume**. When the remaining time is 10 seconds, the monitor issues a reminder tone and the timer flashes in red, prompting you that the run time is to expire.

NOTE

- **You cannot change timer settings when a timer is running.**
 - **You can set Direction, Run Time, and Reminder Volume only for normal, advanced, and cycled timers.**
-

4.1.5 Initiating a Manual Event

To save a manual event, follow this procedure:

1. Select the **Manual Event** quick key to enter the **Manual Event** menu.
2. Select a name for this event, for example **Intubated**, or input a name.
3. Select **OK**. The monitor saves this manual event automatically.

To edit the name of preset event names, select  to enter the Manual Event Setup menu.

You can review the manual events. For more information, see for *16.6 Reviewing Events* details.

4.1.6 Freezing Waveforms

During animal monitoring, the freeze feature allows you to freeze the currently displayed waveforms on the screen so that you can have a close examination of the animal's status. Besides, you can select any frozen waveform for recording. After the waveform is frozen, the waveform on the minitrends screen is displayed and refreshed normally.

4.1.6.1 Viewing Frozen Waveforms

To view the frozen waveforms, follow this procedure:

- Select the  or  button in the Freeze window.
- Slide the frozen waveform leftward or rightward.

At the lower right corner of the bottommost waveform displays the freeze time. The initial frozen time is 0s. With the waveforms scrolling, the freeze time changes at an interval of 1 second. For example, -2 s means the two seconds before the frozen time. This change will be applied for all waveforms on the screen.

NOTE

- You can view the frozen waveforms of up to 120 seconds.

4.1.6.2 Unfreezing Waveforms

To unfreeze the frozen waveforms, select  of the **Freeze** window.

4.1.6.3 Printing Frozen Waveforms

To print the frozen waveforms, select  of the Freeze window and the printer will print the waveform displayed on the current page and parameter values at the freeze time.

4.2 User Screen Settings

The monitor provides different user screens to facilitate animal monitoring in different departments and clinical applications. Access the **Choose Screen** page in either of the following ways:

- Select the **Screen Setup** quick key → select the **Choose Screen** tab.
- Select the **Main Menu** hard key or quick key → from the **Screen Setup** column select **Choose Screen**.

4.2.1 Switching a Screen

You can also quickly switch among the following screens by swiping across the screen with two fingers.

1. Access the **Switch Screen** page in either of the following ways:
 - ◆ Select the **Screen Setup** quick key → select **Switch Screen**.
 - ◆ Select the **Main Menu** hard key or quick key → from the **Screen Setup** column select **Switch Screen**.
2. Select desired screens. When you swipe left or right across the touchscreen with two fingers, the system will switch to the selected screens in the order of **Screen 1, Screen 2, Screen 3, Screen 4**.

4.2.2 Normal Screen

The normal screen is most frequently used for animal monitoring.

4.2.2.1 Entering the Normal Screen

To enter the normal screen, choose any of the following ways:

- Swipe left or right across the touchscreen with two fingers until you switch to the normal screen.
- Select the **Screen Setup** quick key → select the **Choose Screen** tab → select **Normal Screen**.
- Select the **Main Menu** hard key or quick key → from the **Screen Setup** column select **Choose Screen**→select **Normal Screen**.

4.2.2.2 Configuring the Normal Screen

You can configure the parameter numerics, waveforms, and their sequence displayed on the normal screen. To do so, follow this procedure:

1. Access **Tile Layout** in either of the following ways:
 - ◆ Select the **Screen Setup** quick key.
 - ◆ Select the **Main Menu** hard key or quick key → from the **Screen Setup** column select **Tile Layout**.
2. Select a parameter numeric area or waveform area, and then from the popup list select an element you want to display in this area. The parameters and waveforms you did not select will not displayed.

4.2.3 The Big Numerics Screen

The big numerics screen displays parameter numerics in big font size.

4.2.3.1 Entering the Big Numerics Screen

To enter the big numerics screen, choose any of the following ways:

- Swipe left or right across the touchscreen with two fingers until you switch to the big numerics screen.
- Select the **Screen Setup** quick key → select the **Choose Screen** tab →select **Big Numerics**.
- Select the **Main Menu** hard key or quick key →from the **Screen Setup** column select **Choose Screen** →select **Big Numerics**.

4.2.3.2 Configuring the Big Numerics Screen

You can configure an element display in each area. Perform the following procedure:

1. Access the **Screen Setup** page in either of the following ways:
 - ◆ Select the **Screen Setup** quick key.
 - ◆ Select the **Main Menu** hard key or quick key → from the **Screen Setup** column select **Choose Screen**.
2. Select **Big Numerics**.
3. Select an element you want to display in this area.

4.2.4 Minitrends Screen

The **Minitrends** screen is located on the left of the waveform area and shows the recent graphic trends of parameters.

4.2.4.1 Entering the Minitrends Screen

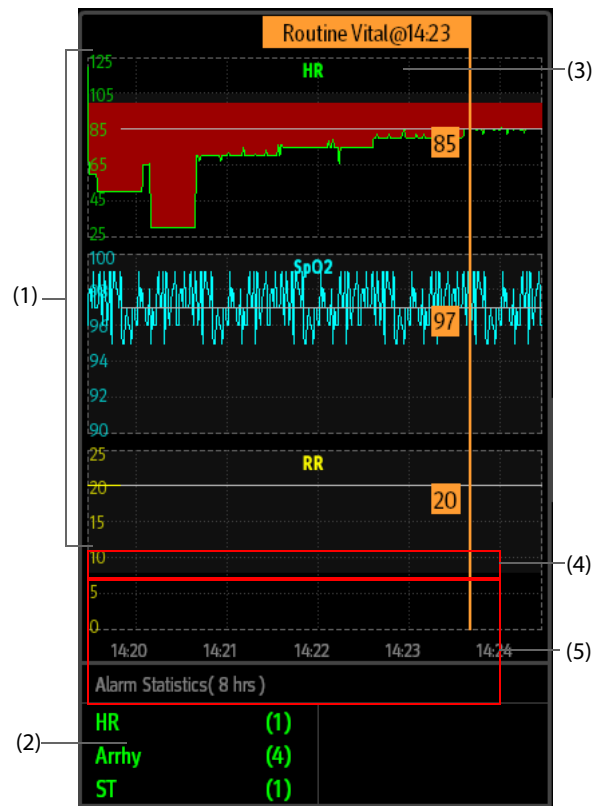
To enter the **Minitrends** screen, choose any of the following ways:

- Swipe left or right across the touchscreen with two fingers until you switch to the **Minitrends** screen.
- Select the **Minitrends** quick key.
- Select the **Screen Setup** quick key → select the **Choose Screen** tab →select **Minitrends**.

- Select the **Main Menu** hard key or quick key → from the **Screen Setup** column select **Choose Screen**→ select **Minitrends**.

4.2.4.2 The Display of Minitrends Screen

The following figure shows the Minitrends screen. Your screen may be configured to look slightly different.



- (1) Scale
- (2) **Routine Vital** button: select this button to set the reference line.
- (3) Routine Vital
- (4) Time line
- (5) Alarm statistics area

4.2.4.3 Setting Minitrends Parameters

You can select to display the specific parameter minitrends on the screen. To set parameters, follow this procedure:

1. Enter the **Minitrends** screen.
2. Select the **Setup** button.
3. Set the desired parameters. If you want to use the default parameters, select **Default Parameter**.

4.2.4.4 Setting the Minitrend Length

To set the Minitrend length, follow this procedure:

1. Enter the **Minitrends** screen.
2. Select the **Setup** button.
3. Set the Minitrend Length.

4.2.4.5 Setting the Alarm Statistics Switch

The **Minitrends** screen can be configured to display the statistic number of physiological alarms in its lower half screen. To set the alarm statistics switch, follow this procedure:

1. Enter the **Minitrends** screen.
2. Select the **Setup** button.
3. Switch on or off the **Alarm Statistics** switch.

4.2.4.6 Setting the Alarm Statistics Duration

The time length within which the alarms statistics are made is configurable. To set the alarm statistics length, follow this procedure:

1. Enter the **Minitrends** screen.
2. Select the **Setup** button.
3. Set **Alarm Statistics Duration**.

4.2.4.7 Routine Vital/Baseline

The Routine vital/Baseline function is used for marking the parameter measurements of certain moment for later reference.

Manually Marking the Routine Vital/Baseline

To manually mark the Routine Vital/Baseline, follow this procedure:

1. Enter the **Minitrends** screen.
2. Select the **Routine Vital** button or **Baseline** button.

NOTE

- If you do not see the **Baseline** button or **Routine Vital** button in the **Minitrends** screen, you can select the **Setup** button and switch on the **Baseline** switch, or set **Routine Vital** to **Manual** or **Auto**.

Configuring Automatic Routine Vital Settings

The monitor can automatically mark the routine vital sign values. To enable this function, follow this procedure:

1. Enter the **Minitrends** screen.
2. Select the **Setup** button.
3. Select **Auto** from the drop-down list of **Routine Vital**.
4. Select **Time** to set the time for marking the first routine vital sign values.
5. Select **Interval** to set the interval for marking the routine vital sign values.

4.3 General Settings

4.3.1 Audio Setup

Select the **Main Menu** hard key or quick key→ from **System** column select **General Setting**, and then set **Alarm Volume**, **High Alarm Volume**, **QRS Volume**, **Key Volume** and **Reminder Volume**.

4.3.1.1 Setting the Date and Time

To set the system time, follow this procedure:

1. Select the **Main Menu** hard key or quick key→ from **System** column select **General Setting**.
2. Set **Date** and **Time**.
3. Set **Date Format**.
4. If you want to use the 12-hour mode, switch off **24-Hour Time**.

5. If you want to use daylight savings time, switch on **Daylight Savings Time**. You can manually switch on or off **Daylight Savings Time** when **Auto Daylight Savings Time** is switched off. For more information, see 20.10.2 *The Daylight Savings Time Tab*.

If your monitor is connected to a central monitoring system (CMS), the date and time are automatically taken from the CMS. In this case, you cannot change the date and time from your monitor.

CAUTION

- **Changing the date and time affects the storage of trends and events and may result in loss of data.**
-

4.3.2 Adjusting the Screen Brightness

You can swipe up and down with one finger on the left part of the main screen to quickly adjust the screen brightness.

Or you can set specific screen brightness by following the procedure below:

1. Select the **Main Menu** hard key or quick key → from **System** column select **General Setting**.
2. If you are using the external power source, set **Brightness**. If you are using the battery to run the monitor, set **Brightness On Battery**.

4.3.3 Setting the Screen Lock Duration

The touchscreen lock period is configurable. To do so, follow this procedure:

1. Select the **Main Menu** hard key or quick key → from **System** column select **General Setting**.
2. Set **Screen Lock Duration**.

4.3.4 Setting eStart Startup Screen

To do so, follow this procedure:

1. Select the **Main Menu** hard key or quick key → from **System** column select **General Setting**.
2. Select whether to switch on the eStart switch.
 - ◆ On: select whether the species selection and weight setting screen is available while startup or discharge animal.
 - ◆ Off: enter the monitoring screen directly after turning on the monitor; enter the standby screen after discharging an animal.

4.4 Other Settings

4.4.1 Configuring the Normal Screen

You can configure the parameter numerics, waveforms, and their sequence displayed on the normal screen. To do so, follow this procedure:

1. Access **Tile Layout** in either of the following ways:
 - ◆ Select the **Screen Setup** quick key → select the **Tile Layout** tab.
 - ◆ Select the **Main Menu** hard key or quick key → from the **Screen Setup** column select **Tile Layout**.
2. Select a parameter numeric area or waveform area, and then from the popup list select an element you want to display in this area. The parameters and waveforms you did not select will not be displayed.

4.4.2 Configuring the Displayed Quick Keys

To select the quick keys you want to display, follow this procedure:

1. Access **Quick Keys** in either of the following ways:
 - ◆ Select the **Screen Setup** quick key → select **Select Quick Keys** tab.
 - ◆ Select the **Main Menu** hard key or quick key → from the **Screen Setup** column select **Quick Keys**.

2. Select the **Current** tab to configure the quick keys you want to display on the screen: from the top of this page, select a block where you want to show a certain quick key, and then select the quick key from the quick key list. For example, if you want to show the **Screen Setup** quick key at the first block, select the first block, and then select **Screen Setup** from the list.

4.4.3 Setting Night Mode

The night mode is a special clinical monitoring mode. To avoid disturbing the animal, you can use the night mode.

You can switch on or off the night mode. This is password protected. For more information, see **Disable Night Mode** in 20.5.5 *The Other Tab*.

4.4.3.1 Entering the Night Mode

Select the **Night Mode** quick key to enter the night mode. You can also follow this procedure to enter the night mode:

1. Select the **Main Menu** hard key or quick key → from the **Screen Setup** column select **Night Mode**.
2. Change the night mode settings if necessary.
3. Select **Enter Night Mode**.

CAUTION

- **Verify the night mode settings before entering the night mode. Pay attention to the potential risk if the setting value is low.**
-

4.4.3.2 Setting the Auto Night Mode Switch

You can configure the monitor to automatically enter and exit the night mode. To do so, follow this procedure:

1. Select the **Main Menu** hard key or quick key → from the **Screen Setup** column select **Night Mode**.
2. Switch on or off **Auto Night Mode**.
 - ◆ **On:** the monitor automatically enters the night mode when the night mode period starts and exits the night mode when the night mode period ends. See 20.10.1 *The Time Synchronization Tab* for the Nighttime setting.
 - ◆ **Off:** the monitor will not automatically enter the night mode. For more information, see 4.4.3.1 *Entering the Night Mode*.

The **Auto Night Mode** switch is **Off** by default.

4.4.3.3 Changing Night Mode Settings

To change night mode settings, follow this procedure:

1. Select the **Main Menu** hard key or quick key → from the **Screen Setup** column select **Night Mode**.
2. Change the follow night mode in the settings as necessary:
 - ◆ Screen brightness
 - ◆ Alarm volume, QRS volume, key-striking volume, and reminder volume
 - ◆ NIBP End Tone switch and Stop NIBP switch

4.4.3.4 Muting All Monitor Sounds

To silence the monitor in the night mode, switch on **All Mute** from the **Night Mode Setup** menu. In night mode, all the monitoring sounds, including the alarm tone, heartbeat tone, key tone, and prompt tone, will be turned off. Local password for accessing the **Maintenance** menu is required for switching on **All Mute**.

4.4.3.5 Exiting the Night Mode

To cancel the night mode, follow this procedure:

- Select the **Night Mode** quick key→ Select **OK**.

- Select the **Main Menu** hard key or quick key → from the **Screen Setup** column select **Exit Night Mode**.

NOTE

- If your monitor is connected to the CMS, it automatically exits the night mode when being disconnected from the CMS.
 - The monitor resumes the previous settings after exiting the night mode.
-

4.4.4 Switching On or Off Parameters

You can also manually switch on or off a parameter when its module is connected. If setting parameter switches is not password protected, follow this procedure to set parameter switches:

1. Access **Parameters On/Off** by any of the following ways:
 - ◆ Select the **Screen Setup** quick key → select the **Parameters On/Off** tab.
 - ◆ Select the **Main Menu** hard key or quick key → from the **Parameters** column select **Parameters On/Off**.
2. Switch on or off the desired parameters.

If setting parameter switches is password protected, see 20.11 *The Other Settings* to set parameter switches.

4.4.5 Changing Measurement Colors

You can set the color of measurement values and waveforms for each parameter. To do so, follow this procedure:

1. Select the **Main Menu** hard key or quick key → from the **Parameters** column select **Parameters Color**.
2. Select the **Current** tab and set the colors of the currently monitoring measurement values and waveforms.
3. Select the **All** tab and set the colors of measurement values and waveforms for all parameters.

4.5 Managing Configurations

When continuously monitoring an animal, the clinical professional often needs to adjust the monitor's settings according to the animal's condition. The collection of all these settings is called a configuration. You can change some settings from a certain set of configuration and then save the changed configuration as a user configuration.

WARNING

- The configuration management function is password protected. The configuration management tasks must be performed by clinical professionals.
-

4.5.1 Setting Default Species

To set the default species when admitting a new animal, follow this procedure:

1. Select the **Main Menu** hard key or quick key → from **System** column select **Load Conf**.
2. Select the factory default.

4.5.2 Setting Default Configuration

The monitor will load the pre-set default configuration in the following cases:

- An animal is admitted.
- An animal is discharged.
- Species is changed.

The default configuration can be the latest configuration, factory configuration or user configuration.

To set the default configuration, follow this procedure:

1. Select the **Main Menu** hard key or quick key → from **System** column select **Load Config** → **Configuration Management** → input the password → select Enter key.
2. Select **Select Default Config**.
3. Select **Load the Latest Config** or **Load Specified Config**.
 - ◆ When you select **Load the Latest Config**, the latest configuration is loaded when the monitor is started or an animal is admitted
 - ◆ When you select **Load Specified Config**, the specific configurations are loaded when the monitor is started or an animal is admitted.

4.5.3 Saving Current Settings

Current settings can be saved as a user configuration. Up to 25 user configurations can be saved. To save current settings, follow this procedure:

1. Select the **Main Menu** hard key or quick key → from **System** column select **Load Config** → **Configuration Management** → input the password → select Enter key.
2. Select **Save Current Settings**.
3. Input the configuration name.
4. Select **OK**.

4.5.4 Delete Configuration

To delete a configuration, follow this procedure:

1. Select the **Main Menu** hard key or quick key → from **System** column select **Load Config** → **Configuration Management** → input the password → select Enter key.
2. Select **Delete Configuration** button.
3. Select the configuration you want to delete.
 - ◆ In the **Delete Configuration** menu, selecting **Local** tab shows the existing user configurations on the monitor.
 - ◆ In the **Delete Configuration** menu, selecting **USB Drive** tab shows the existing user configurations on the USB drive.
4. Select the **Routine Vital** button or **Baseline** button.
5. Select **OK**.

4.5.5 Transferring a Configuration

The monitor provides the function of configuration transfer. When installing several monitors with identical user configurations, it is not necessary to set each unit separately. Use a USB drive to transfer the configuration from monitor to monitor.

4.5.5.1 Exporting a Configuration

To export the current monitor's configuration, follow this procedure:

1. Connect the USB drive to the monitor's USB connector.
2. Select the **Main Menu** hard key or quick key → from **System** column select **Load Config** → **Configuration Management** → input the password → select Enter key.
3. Select **Export Configuration**.
4. Select the configurations and **User Maintenance Settings** to export.
5. Select **Export**.

4.5.5.2 Importing a Configuration

To import the configuration from the USB drive to the monitor, follow this procedure:

1. Connect the USB drive that has saved the configuration file to the monitor's USB port.

2. Select the **Main Menu** hard key or quick key → from **System** column select **Load Config**→**Configuration Management**→input the password→ select Enter key.
3. Select **Import Configuration**.
4. Select the configurations and **User Maintenance Settings** to import.
5. Select **Import**.

4.5.6 Printing Configurations

To print factory configurations and user configurations, follow this procedure:

1. Select the **Main Menu** hard key or quick key → from **System** column select **Load Config** →**Configuration Management**→ input the password→ select Enter key.
2. Select the **Print Configuration**.
3. Select desired configurations.
4. Select **Print**.

4.5.7 Modifying Configuration Password

To modify the configuration password, follow this procedure:

1. Select the **Main Menu** hard key or quick key → from **System** column select **Load Config**→**Configuration Management**→ input the password→ select Enter key.
2. Select **Modify Password**.
3. Input the old password and new password respectively.
4. Select **OK**.

4.5.8 Loading Configurations

NOTE

-
- **The monitor may configure some settings by default when you load a configuration of different software version with the current configuration.**
-

You may make changes to some settings during operation. However, these changes or the pre-selected configuration may not be appropriate for the newly admitted animal. Therefore, the monitor allows you to load a desired configuration to ensure that all the settings are appropriate for your animal.

To load a configuration, follow this procedure:

1. Select the **Main Menu** hard key or quick key →from **Configuration** column select **Load Config**.
2. Select the desired configuration.
 - ◆ Select the configuration on this monitor in the **Local** page.
 - ◆ Select the configuration on the USB drive in the **USB Drive** page.
3. Select **Load**.

5 Managing Animals

5.1 Discharging an Animal

Before monitoring a new animal, discharge the previous animal. After the animal is discharged, the technical alarms is reset, and monitor settings return to their defaults.

After an animal is discharged, the monitor automatically admits a new animal.

WARNING

- **Discharge the previous animal before starting monitoring a new animal. Otherwise there may be risk of mixing animal data.**
-

5.1.1 Auto Discharging an Animal

The monitor automatically discharge after the monitor has been switched off normally.

5.1.2 Manually Discharging an Animal

To manually discharge an animal, choose any of the following ways:

- Swipe down the touchscreen with two fingers.
- Select the **Discharge Patient** quick key.
- Select the animal information area at the upper left corner of the screen → **Discharge Patient**.
- Select the **Patient Information** quick key → **Discharge Patient**.
- Select the **Main Menu** hard key or quick key → from the **Patient Management** column select **Discharge**.

Select the desired item from the popup box:

- **Print End Case Report:** prints the end case report when the animal is discharged.
- **Discharge:** clears the waveform data of the current animal. The monitor loads the default configuration and goes to the standby mode. The current animal becomes a discharged animal.
- **Clear Patient Data:** discharges the current animal and clears the waveform data. The monitor loads the default configuration and does not go to the standby mode. The current animal becomes a discharged animal.

5.2 Admitting an Animal

The monitor admits a new animal in the following situations:

- After an animal is manually discharged, the monitor automatically admits a new animal.
- After being switched off for the selected time period, the monitor automatically discharges the previous animal and admits a new animal at startup.
- If the monitor has not detected certain animal vital signs (ECG, SpO2, PR, RR, NIBP) for 30 minutes, you will be prompted whether to start monitoring a new animal if any of the above vital signs are detected again.

Always inputs animal information as soon as the animal is admitted. For more information, see *5.3.2 Editing Animal Information*.

WARNING

- The settings of species and paced status always contain a default value, regardless of whether the animal is admitted or not. Check if the setting is correct for your animal.
 - For paced animals, set Paced to Yes. Otherwise the monitor could mistake a pace pulse for a QRS complex and fail to generate alarms when the ECG signal is too weak.
 - For non-paced animals, you must set Paced to No.
-

5.3 Managing Animal Information

5.3.1 Entering the Animal Information Menu

Use any of the following methods to enter the **Patient Information** menu:

- Select the animal information area at the top left corner of the screen.
- Select the **Patient Information** quick key.
- Select the **Main Menu** hard key or quick key → from the **Patient Management** column select **Patient Information**.

5.3.2 Editing Animal Information

Edit animal information after an animal has been admitted, or when animal information is incomplete, or when you want to change animal information:

To edit the animal information, follow this procedure:

1. Enter the **Patient Information** menu. For more information, see *5.3.1 Entering the Animal Information Menu*.
2. Edit animal information as required.

If you connect a barcode reader with your monitor, you can scan the animal's barcode to enter animal information.

NOTE

- The monitor will reload the configuration if you change the species.
-

5.3.3 Loading Animal Information from the CMS

If the monitor is connected to the central monitoring system (CMS). You can load animal information from the CMS to the monitor. To do so, follow this procedure:

1. Enter the **Find Patient** menu in either of the following ways:
 - ◆ Select the **Main Menu** hard key or quick key → from the **Patient Management** column select **Find Patient**.
 - ◆ From the **Patient Information** menu select **Find Patient**.
2. Input query criteria.
3. Select **Search**. Then a list pops up, including all the animals that meet the query criteria.
4. Select an animal from the animal list, and then select **Import**. Corresponding animal information in the monitor will be updated.

5.4 Exporting Animal Data

You can export the demographic information and monitoring data of the current and discharged animals via a USB drive. For more information, see *20.7.4 The Export Tab*.

5.5 Deleting Animal Data

To delete the data of discharged animals, follow this procedure:

1. Access the **Discharged Patients** dialog box by either of the following ways:
 - ◆ Select the **Discharged Patients** quick key.
 - ◆ Select the **Main Menu** hard key or quick key → from the **Patient Management** column select **Discharged Patients**.
2. From the animal list select desired animals.
3. Select **Delete**.

6 Networked Monitoring

6.1 Network Introduction

You can connect the monitor to the central monitoring system (CMS), and other devices through wired LAN or wireless LAN.

6.2 Network Safety Information

CAUTION

- **Wireless network design, deployment, debugging, and maintenance should be executed by Mindray Animal Medical service personnel or authorized technicians.**
 - **Always deploy the wireless network according to local wireless regulations.**
 - **Using 5G frequency band is recommended whenever possible. There are more interference sources in 2.4G frequency band.**
 - **Private APs and wireless routers are not allowed. These devices may cause radio interference and result in monitor and CMS data loss.**
 - **To ensure network security and stability, data communication must be performed within a closed network or within a virtually isolated hospital network. The hospital is responsible for ensuring the security of the virtually isolated network.**
 - **WPA2-PSK and WPA2-Enterprise verification and encryption should be used if possible. Otherwise, the equipment may not be able to work or animal information may be leaked. WPA2-Enterprise and a long password are recommended.**
 - **Keep network authentication information, for example password, from being accessed by unauthorized users.**
 - **Do not connect non-medical devices to the monitor network.**
 - **If wireless network signal is poor, there may be a risk of CMS data loss.**
 - **Maximum number of monitors connected to a single AP is 16. Too many monitors connected to the same AP may result in network disconnection.**
 - **RF interference may result in wireless network disconnection.**
 - **Disconnecting from the network may result in CMS data loss and function failure. Check the animal in case of network disconnection and reconnect the network as soon as possible.**
 - **Ensure that the monitor IP address setting is correct. Changing the network settings may result in network disconnection. Contact the Customer Service Department or your local distributor if you have any problems on setting the IP address.**
-

6.3 Connecting the Monitor to the CMS

NOTE

You can obtain the user name, password and sever address of the cloud CMS through the following methods:

- **See the accompanying installation package of cloud CMS.**
 - **Contact the Customer Service Department or sales representative.**
-

You can connect the monitor to the Central Monitoring System (CMS) through wired LAN or wireless LAN. When connected to the CMS, the system provides the following function:

- The monitor can transmit parameter values, waveforms, alarm settings, and events to the CMS. From the CMS, you can check the animal's monitoring data and alarms.

- Animal information, alarm settings, and alarm status can be synchronized between the monitor and the CMS.
- You can start or stop NIBP measurements from the CMS.
- In case of network disconnection, the monitor can transmit the offline data to the CMS when network is reconnected.

6.3.1 Connecting to the CMS through Wired Network

To connect the monitor to the CMS, set that the monitor and the CMS are on the same network segment when the monitor is connected to the CMS through wired network. Perform the following procedure:

1. Use a network cable to connect the monitor to the LAN where the CMS resides.
2. Perform the network settings on the monitor:

Maintenance			
XXX	XXX	XXX	Network Setup
Network Type	Monitor LAN1 IP		
LAN1 IP			
WLAN			
Central Station Setup			

- a. Select the **Main Menu** hard key or quick key → from the **System** column select **Maintenance** → input the required password → select Enter key.
 - b. Select the **Network Setup** → from the **Network Type** tab select **LAN1 IP**.
 - c. From the LAN1 IP tab select **Obtain IP Address Automatically** or set the network information manually.
 - d. On the **Central Station Setup** tab, enable **Select CMS**.
 - e. Select **Add Local Central Station** to add the local CMS or select **Add Cloud Central Station** to add the cloud CMS.
3. Select the system status information area in the upper right corner of the main screen. Select the desired CMS from the popup CMS list.
 4. Admit the monitor at the CMS. For detailed procedure, see the operator's manuals of the CMS.

6.3.2 Connecting to the CMS through Wireless Network

When the monitor is connected to the CMS through wireless network, the monitor and CMS should use the same wireless network. Perform the following procedure:

1. Perform the network settings on the monitor:
 - a. Select the **Main Menu** hard key or quick key → from the **System** column select **Maintenance** → input the required password → select Enter key.
 - b. Select the **Network Setup** → from the **Network Type** tab select **WLAN**.

- c. On the **Available Network List** of the **WLAN**, select the same network as that of the CMS.
 - d. On the **Central Station Setup** tab, enable **Select CMS**.
 - e. Select **Add Local Central Station** to add the local CMS or select **Add Cloud Central Station** to add the cloud CMS.
2. Select the system status information area in the upper right corner of the main screen. Select the desired CMS from the popup list.
 3. Admit the monitor at the CMS. For detailed procedure, see the operator's manuals of the CMS.

6.4 Connecting the Monitor to the Anesthesia Machine

The monitor can be connected to the Veta 5 series anesthesia machine manufactured by Mindray Animal Medical and transfers CO₂ data to the anesthesia machine

6.4.1 Connecting to the Anesthesia Machine through a Network Cable

Perform the following procedure:

1. Use a network cable to connect the network interface of the anesthesia machine and the monitor separately.
2. Set the network on the monitor so that the monitor and the anesthesia machine are in the same network segment and the subnet mask.
 - a. Select the **Main Menu** hard key or quick key → from the **System** column select **Maintenance** → input the required password → select Enter key.
 - b. Select the **Network Setup** → from the **Network Type** tab select **LAN1 IP**.
 - c. From the **LAN1 IP** tab select **Obtain IP Address Automatically** or set the network information manually.
3. Perform the related procedure on the Monitor Device Connection tab of the anesthesia machine. For details, see the operator's manuals of the Anesthesia Machine.

6.4.2 Connecting to the Anesthesia Machine through the Same LAN

When the monitor and the anesthesia machine are in the same LAN (Local Area Network) by using 2 network cables, perform the following procedure:

1. Use 2 network cables to connect the anesthesia machine and the monitor to the same LAN.
2. Set the network on the monitor so that the monitor and the anesthesia machine are in the same network segment and the subnet mask.
3. Perform the related procedure on the Monitor Device Connection tab of the anesthesia machine. For details, see the operator's manuals of the Anesthesia Machine.

6.5 MLDAP

MLDAP refers to Mindray Animal Medical LDAP (Lightweight Directory Access Protocol). It is an independent process which can be installed on other application server (Windows). MLDAP provides user identity and authentication.

The MLDAP server is connected with the hospital LDAP server. All monitoring devices are connected to the MLDAP server to implement identity and authentication for the following operations:

- Changing alarm settings
- Changing arrhythmia settings
- Accessing the **Maintenance** menu

For more information on setting the MLDAP server, see 20.16.9 *The MLDAP Tab*. For more information on selecting or changing the passwords, see 20.12 *The Authorization Setup Settings*.

6.6 Wireless Network

6.6.1 Connecting the Wireless Network

You can add up to 5 wireless networks for the monitor. If connecting the current wireless network fails, the monitor automatically connects other wireless networks in the order when they were added.

To manually switch the wireless network, from the system status information area on the upper right corner of the screen select , and select the desired wireless network.

6.6.2 Disconnecting the Wireless Network

To disconnect the wireless network manually, follow this procedure:

1. Swipe the screen from top down with a single finger.
2. Select .

To reconnect the wireless network after it is disconnected manually, follow this procedure:

1. Swipe the screen from top down with a single finger.
2. Select .

7 Alarms

7.1 Alarm Introduction

This chapter describes alarm functions and alarm settings.

7.2 Alarm Safety Information

WARNING

- A potential hazard can exist if different alarm presets and default configuration settings are used for the same or similar equipment in the same care area, for example, an intensive care unit or cardiac operating room.
 - If your monitor is connected to the central monitoring system (CMS), alarms can be presented and controlled remotely. Remote suspension, inhibition, or reset of monitor alarms via the CMS may cause a potential hazard. For more information, see the operator's manuals of the CMS.
 - The monitors in the care area may each have different alarm settings to suit different animals. Before starting monitoring, check that the alarm settings are appropriate for the animal. Always make sure that necessary alarm limits are active and set according to the animal's clinical condition.
 - Setting alarm limits to extreme values may cause the alarm system to become ineffective.
 - When the alarm sound is switched off, the monitor gives no alarm tones even if a new alarm occurs. Be careful about whether to switch off the alarm sound or not. When the alarms are off or while alarm audio is paused either temporarily or indefinitely, observe the animal frequently.
 - When monitoring animals that are not continuously attended by a clinical operator, properly configure the alarm system and adjust alarm settings as per the animal's condition.
 - Do not exclusively rely on audible alarms for animal monitoring. Adjusting alarm volume to a low level or turning off alarm sound may result in animal hazards. Always make sure that the audio alarm volume level is adequate in your care environment. Always keep the animal under close surveillance.
-

7.3 Understanding the Alarms

7.3.1 Alarm Categories

The monitor has two different types of alarms: physiological alarms and technical alarms.

- Physiological alarms are triggered by animal measurement exceeding the parameter limits, or by an abnormal animal conditions.
- Technical alarms are triggered by an electrical, mechanical, or other monitor failure, or by failure of a sensor or component. Technical alarm conditions may also be caused when an algorithm cannot classify or interpret the available data.

Apart from the physiological and technical alarms, the monitor can also prompt some messages telling the system status or animal status.

7.3.2 Alarm Priorities

By severity, the alarms are classified into the following priority levels:

- High priority alarms: indicates a life threatening situation or a severe device malfunction. High priority alarms require an immediate response.
- Medium priority alarms: indicates abnormal vital signs or a device malfunction. Medium priority alarms require a prompt response.
- Low priority alarms: indicates a discomfort condition, a device malfunction, or an improper operation. Low priority alarms require you to be aware of this condition.
- Messages: provides additional information on the animal or the equipment.

7.3.3 Alarm Indicators

When an alarm occurs, the monitor indicates it to you through visual or audible alarm indications. For more information, see the following table.

Alarm Indicator		High Priority Alarm	Medium Priority Alarm	Low Priority Alarm	Message	Comments
Alarm lamp		Red Flashing frequency: 1.4 - 2.8 Hz Duty cycle: 20 - 60% on	Yellow Flashing frequency: 0.4 - 0.8 Hz Duty cycle: 20 - 60% on	Yellow No flashing Duty cycle: 100% on	None	None
Audible tone pattern	ISO	Repeat pattern of triple + double + triple + double beeps	Repeat pattern of triple beeps	Single beep	None	None
Alarm message		White text inside a red box	Black text inside a yellow box	Black text inside a yellow box	White text	Alarm messages are displayed in the alarm information area at the top of the screen. You can select the alarm messages to show the alarm list.
Alarm priority indicator		!!!	!!	!	None	The indicator shows in front of corresponding alarm message.
Parameter value		White text inside a flashing red box	Black text inside a flashing yellow box	Black text inside a flashing yellow box	None	None

NOTE

- When multiple alarms of different priority levels occur simultaneously, the monitor selects the alarm of the highest priority to light the alarm lamp and issues the alarm tone.
- When multiple technical alarms of different priority levels occur simultaneously and should be displayed in the same area, the monitor only displays the messages of the highest priority alarm.
- When multiple physiological alarms of different priority levels occur simultaneously and should be displayed in the same area, the monitor displays the high priority alarm, while the medium and low priority alarms are displayed circularly.
- When multiple alarms of the same priority levels occur simultaneously, alarm messages are displayed circularly.
- Lethal arrhythmia alarms, apnea, and SpO₂ Desat are exclusive high priority alarms. When these alarms occur, the monitor only displays messages of exclusive alarms. Other high priority alarms will not be displayed. When multiple exclusive alarms occur simultaneously, alarm messages are displayed circularly.

7.3.4 Alarm Status Symbols

Apart from the alarm indicators as described in **7.3.3 Alarm Indicators**, the monitor uses the following symbols to indicate the alarm status:



Alarm pause: indicates that all the alarms are paused.



Alarm off: indicates that individual measurement alarms are turned off or the system is in the alarm off status.



Audio pause: indicates that audible alarm tones are paused.



Audio off: indicates that audible alarm tones are turned off.



Alarm reset: indicates that the alarm system is reset.

7.4 Accessing On-screen Help for Technical Alarms (AlarmSight)

In the technical alarm list, alarm messages followed by **Detail** include help messages or pictures to help you identify the problem. This function is called AlarmSight. To access AlarmSight, follow this procedure:

1. Select the technical alarm information area to enter the **Alarms** window.
2. Select the **Technical Alarms** tab.
3. From the alarm list select the desired alarm.

7.5 Checking Physiological Alarm List

To check the physiological alarm list, follow this procedure:

1. Select the physiological alarm information area to enter the **Alarms** window.
2. Select the **Physiological Alarms** tab.

7.6 Changing Alarm Settings

Select the **Alarm Setup** quick key or from the **Alarm Setup** column of the main menu select desired buttons to set alarm properties.

7.6.1 Setting Parameter Alarm Properties

To set parameter alarm properties, follow this procedure:

1. Access the **Limits** page in either of the following ways:
 - ◆ Select the **Alarm Setup** quick key.
 - ◆ Select the **Main Menu** hard key or quick key → from the **Alarm Setup** column select **Limits**.
2. Select a parameter tab and set alarm properties as desired. Input the password if required. For more information, see *20.12 The Authorization Setup Settings*.

You can also change the alarm properties of individual parameter from corresponding parameter menu.

7.6.2 Setting Alarm Tone Properties

7.6.2.1 Changing the Alarm Volume

You can swipe up and down with one finger on the right part of the main screen to quickly change alarm volume.

Or you can set specific alarm volume by following the procedure below:

1. Access the **Setup** page in either of the following ways:
 - ◆ Select the **Alarm Setup** quick key → select the **Setup** tab.
 - ◆ Select the **Main Menu** hard key or quick key → from the **Alarm Setup** column select **Setup**.
2. Set **Alarm Volume**. The optional alarm volume is between X to 10, in which X is the minimum volume, depending on the setting of minimum alarm volume, and 10 is the maximum volume.
3. Select **High Alarm Volume** to set the volume of the high priority alarm.
4. Select **Reminder Volume** to set the volume of the reminder tone.

NOTE

- When Alarm Volume is set to 0, the alarm sound is turned off and the audio off symbol appears on the screen.
- You cannot set the volume of high priority alarms if Alarm Volume is set to 0.

7.6.2.2 Password Protected Audio Alarm Settings

The following alarm settings are password protected:

- Minimum alarm volume
- Alarm sound pattern
- Alarm interval
- Alarm sound escalation switch and delay

For more information, see 20.5.1 The Audio Tab.

7.6.3 Initiating Auto Alarm Limits

The monitor provides the auto alarm limits function to automatically adjust alarm limits according to the animal's vital signs using. When auto limits are selected, the monitor calculates safe auto limits based on the latest measured values. To get accurate auto alarm limits, you need to collect a set of measured vital signs as a baseline.

To initiate auto alarm limits, follow this procedure:

1. Access the **Limits** page in either of the following ways:
 - ◆ Select the **Alarm Setup** quick key.
 - ◆ Select the **Main Menu** hard key or quick key → from the **Alarm Setup** column select **Limits**.
2. From the **Limits** page, select **Auto Limits** at the left bottom.
3. Select **OK** from the popup dialog box.

Then the monitor will automatically calculate alarm limits basing on the latest measured values. Before applying these automatically created alarm limits, confirm if they are appropriate for your animal from the **Limits** menu. If not, you can adjust them manually. These alarm limits will remain unchanged until you select auto limits again or adjust them manually.

The monitor calculates auto limits basing on the following rules:

Module	Parameter	Lower Limit	Upper Limit	Auto Limit Range
ECG	HR/PR (bpm)	(HR - 30) or 90 (whichever is greater)	(HR + 40) or 200 (whichever is smaller)	55 to 225
Resp	RR (rpm)	(RR - 10) or 30 (whichever is greater)	(RR + 25) or 85 (whichever is smaller)	10 to 90
SpO ₂	SpO ₂ (%)	Same as the default alarm limit	Same as the default alarm limit	Same as the measurement range

Module	Parameter	Lower Limit	Upper Limit	Auto Limit Range
NIBP	NIBP-S (mmHg)	$(SYS \times 0.68 + 10)$	$(SYS \times 0.86 + 38)$	Weight >23kg or >50 lb: 45 to 270 Weight 10 to 23 kg or 21 to 50 lb: 45 to 185 Weight <10 kg or <21 lb: 45 to 185
	NIBP-D (mmHg)	$(Dia \times 0.68 + 6)$	$(Dia \times 0.86 + 32)$	Weight >23kg or >50 lb: 25 to 225 Weight 10 to 23 kg or 21 to 50 lb: 25 to 150 Weight <10 kg or <21 lb: 25 to 150
	NIBP-M (mmHg)	$(Mean \times 0.68 + 8)$	$(Mean \times 0.86 + 35)$	Weight >23kg or >50 lb: 30 to 245 Weight 10 to 23 kg or 21 to 50 lb: 30 to 180 Weight <10 kg or <21 lb: 30 to 180
Temp (xx refers to temperature site)	Txx (°C)	$(Txx - 0.5)$	$(Txx + 0.5)$	1 to 49
	TD (°C)	Same as the default alarm limit	Same as the default alarm limit	Same as the measurement range
IBP: ART/Ao/UAP/ BAP/FAP/LV/P1-P4 (Arterial pressure)	IBP-S (mmHg)	$(SYS - 15)$ or 45 (whichever is greater)	$(SYS + 15)$ or 105 (whichever is smaller)	35 to 115
	IBP-D (mmHg)	$(Dia - 15)$ or 20 (whichever is greater)	$(Dia + 15)$ or 80 (whichever is smaller)	20 to 90
	IBP-M (mmHg)	$(Mean - 15)$ or 35 (whichever is greater)	$(Mean + 15)$ or 95 (whichever is smaller)	25 to 105
IBP: PA	IBP-S (mmHg)	$SYS \times 0.75$	$SYS \times 1.25$	3 to 120
	IBP-D (mmHg)	$Dia \times 0.75$	$Dia \times 1.25$	
	IBP-M (mmHg)	$Mean \times 0.75$	$Mean \times 1.25$	
IBP: CVP/LAP/RAP/ UVP/P1-P4 (Venous pressure)	IBP-M	$Mean \times 0.75$	$Mean \times 1.25$	3 to 40
C.O.	TB (°C)	$(TB - 1)$	$(TB + 1)$	Same as the measurement range
CO ₂	EtCO ₂ (mmHg)	0 to 32: remains the same	0 to 32: remains the same	Same as the measurement range
		33 to 35: 29	33 to 35: 41	
		36 to 45: $(EtCO_2 - 6)$	36 to 45: $(EtCO_2 + 6)$	
		46 to 48: 39	46 to 48: 51	
		>48: remains the same	>48: remains the same	
	FiCO ₂	None	Same as the default alarm limit	10 to 90
	awRR (rpm)	$(awRR - 10)$ or 30 (whichever is greater)	$(awRR + 25)$ or 85 rpm (whichever is smaller)	

7.6.4 Setting the Alarm Delay Time

For continuously measured parameters, you can set the alarm delay time. If the alarm condition is resolved within the delay time, the monitor does not present the alarm.

This setting is password protected. For more information, see 20.5.5 *The Other Tab*.

The setting of **Alarm Delay** is not applied to the apnea alarms and the ST alarms. You can set **Apnea Delay** and **ST Alarm Delay** separately; for details, see 7.6.5 *Setting the Apnea Delay Time* and 20.5.5 *The Other Tab*.

WARNING

- **The alarm delay time can be set to a maximum of 15 seconds. Changing this setting to an inappropriate level could result in a hazard to the animal.**
-

7.6.5 Setting the Apnea Delay Time

To set the apnea delay time, follow this procedure:

1. Access the **Setup** page in either of the following ways:
 - ◆ Select the **Alarm Setup** quick key → select the **Setup** tab.
 - ◆ Select the **Main Menu** hard key or quick key → from the **Alarm Setup** column select **Setup**.
2. Select **Apnea Delay** to set the apnea delay time.

7.6.6 Restoring the Default Alarm Settings

To reset all alarm settings to the defaults, follow this procedure:

1. Access the **Limits** page in either of the following ways:
 - ◆ Select the **Alarm Setup** quick key.
 - ◆ Select the **Main Menu** hard key or quick key → from the **Alarm Setup** column select **Limits**.
2. Select **Defaults** at the bottom.

7.6.7 Setting the Length of Printed Waveforms

You can define the length of printed waveforms when an alarm is triggered. To do so, follow this procedure:

1. Access the **Setup** page in either of the following ways:
 - ◆ Select the **Alarm Setup** quick key → select the **Setup** tab.
 - ◆ Select the **Main Menu** hard key or quick key → from the **Alarm Setup** column select **Setup**.
2. Set **Printing Duration On Alarm**.

7.6.8 Setting the Trend Alarms

The monitor provides trend alarms of multiple parameter measurements.

1. Access the **Trend Alarm** in either of the following ways:
 - ◆ Select the **Alarm Setup** quick key → **Trend Alarm** tab.
 - ◆ Select the **Main Menu** hard key or quick key → from the **Alarm Setup** column select **Trend Alarm**.
2. Set alarm properties as desired. For example, change the default alarm priority.

NOTE

- **You can only change the default alarm priority of custom trend alarms.**
 - **You can only select the icon type of the custom trend alarms. In the iStatus window, selected icon type is used to indicate the alarmed system or organ.**
 - **You can only delete custom trend alarms.**
-

7.6.9 Setting the Switch of the SpO₂ Desat Alarm Off

You can choose whether switching off the SpO₂ Desat alarm is permissible or not. This setting is password protected. For more information, see 20.5.5 *The Other Tab*.

WARNING

- If you switch off the SpO₂ Desat alarm, the monitor will not alarm when the animal's SpO₂ is extremely low. This may result in a hazard to the animal. Always keep the animal under close surveillance.
-

7.6.10 Setting the Switch of the Apnea Alarm Off

You can choose whether switching off the apnea alarm is permissible or not. This setting is password protected. For more information, see 20.5.5 *The Other Tab*.

WARNING

- If you switch off the apnea alarm, the monitor will not issue the apnea alarm in case that apnea happens. This may result in a hazard to the animal. Keep the animal under close surveillance.
-

7.7 Pausing Alarms/Pausing Alarm Tones

7.7.1 Defining the Pause Function

You can either pause alarms or pause alarm tones. This depends on the pause setting. This setting is password protected. For more information, see 20.5.2 *The Pause/Reset Tab*.

7.7.2 Pausing Alarms

If the pause function is designated as pausing alarms, the following rules are followed:

- No physiological alarm will be presented.
- Except battery-related technical alarms, sounds of other technical alarms are paused, but alarm lamps and alarm messages remain presented.
- The remaining alarm pause time is displayed in the physiological alarm information area.
- The alarm pause symbol is displayed in the system information area.

When the alarm pause time expires, the alarm paused status is automatically deactivated.

The following alarm pause and alarm reset settings are password protected.

- Alarm pause time
- Priorities of paused alarms
- Alarm reset setting
- Reminder tone settings

For more information, see 20.5.2 *The Pause/Reset Tab*.

7.7.3 Switching Off All Alarms

If the pause function is designated as pausing alarms and **Pause Time** is set to **Permanent** (see 20.5.2 *The Pause/Reset Tab*), the alarm off status has the following features:

- Physiological alarms are switched off. The alarm lamp does not flash and alarm sound is not issued.
- Alarm sound of technical alarms is switched off, but alarm lamp flashes and alarm messages are presented.
- The message **Alarm Off** with red background is displayed in the physiological alarm information area.

- The alarm off symbol is displayed in the system status information area.

WARNING

- **Pausing or switching off alarms may result in a hazard to the animal.**
-

7.7.4 Pausing Alarm Sound

If the pause function is defined as **Audio Pause**, pressing the **Audio Pause** key pauses alarm tone. When alarm tones are paused, the following rules are followed:

- The sound of all physiological alarms and technical alarms are switched off.
- The remaining audio pause time is displayed in the physiological alarm information area.
- The audio pause symbol is displayed in the system information area.

When the audio pause time expires, the audio paused status is automatically deactivated. You can also cancel the audio paused status by pressing the **Audio Pause** quick key.

7.7.4.1 Setting the Alarm Tone Pause Time

The alarm tone pause time can be set to **1 min**, **2 min**, **3 min**, or **Permanent**. The default audio pause time is two minutes.

This function is password protected. For more information, see *20.5.2 The Pause/Reset Tab*.

7.7.4.2 Prolonging the Alarm Tone Pause Time

You can temporarily prolong the alarm tone pause time after the monitor enters the alarm tone paused status. This function is password protected. For more information, see *20.5.2 The Pause/Reset Tab*.

NOTE

- **Prolonging alarm pause time does not affect the setting of alarm tone pause time.**
-

7.7.4.3 Setting the Priority of Audio Paused Alarms

You can select alarm sound of what priority can be paused. This function is password protected. For more information, see *20.5.2 The Pause/Reset Tab*.

7.7.4.4 Switching Off Alarm Sound

If **Pause Time** is set to **Permanent** (see *20.5.2 The Pause/Reset Tab*), pressing the **Audio Pause** quick key permanently switches off all alarm sound. The audio off status has the following features:

- Alarm sound of both physiological alarms and technical alarms is switched off.
- The audio off symbol is displayed in the system information area.

To exit the audio off status, press the **Audio Pause** quick key again.

WARNING

- **Pausing or switching off alarm sound may result in a hazard to the animal.**
-

7.8 Resetting Alarms

Pressing the **Alarm Reset** quick key to reset the alarm system. When the alarm system is reset, the alarm reset symbol displays in the system status information area for alarm symbols.

NOTE

- **If a new alarm is triggered after the alarm system is reset, the alarm reset icon will disappear and the alarm light and alarm tone will be reactivated.**
-

7.8.1 Resetting Physiological Alarms

Physiological alarms give different alarm indicators when the alarm system is reset:

- The alarm sound is silenced.
- A √ appears before the alarm message.
- The color of the parameter numeric background corresponds with the alarm priority, but the parameter numeric does not flash.

7.8.2 Resetting Technical Alarms

Technical alarms give different alarm indicators when the alarm system is reset:

- Some technical alarms are cleared. The monitor gives no alarm indications.
- Some technical alarms are changed to the prompt messages.
- For some technical alarms, the alarm is silenced and a √ appears before the alarm message.

For details about the indications of technical alarms when the alarm system is reset, see *D.2 Technical Alarm Messages*.

7.9 Latching Alarms

The latching setting for physiological alarms defines how alarm indicators behave if you do not reset the alarms.

- If you do not “latch” physiological alarms, their alarm indications disappear when the alarm condition ends.
- If you “latch” physiological alarms, all visual and audible alarm indications remain until you reset the alarms. For latched alarms the time when the alarm is last triggered is displayed behind the alarm message.

You can separately latch visual indications or simultaneously latch the visual and the audible indications.

- When visual indications are latched, visual indications, including alarm lamp, alarm message and its background remain when the alarm condition ends and the time when the alarm last triggered is displayed behind the alarm message.
- When audible indications are latched, the monitor issues alarm sounds when the alarm condition ends.

The alarm latch settings is password protected. For more information, see *20.5.3 The Latching Tab*.

NOTE

- **Changing alarm priority may affect the latching status of corresponding alarm. Determine if you need to reset the alarm latching status if you changed the alarm priority.**
 - **When the alarm system is reset, latched physiological alarms are cleared.**
-

7.10 Calling for Help

In case of needing a help, you can call monitors in the same department and the Central Monitoring System (CMS) from your monitor so that nearby doctors and nurses can come for help.

To call help, select the **Call Help** quick key and select **OK** from the popup dialog box. If you do not select **OK**, the monitor will automatically send out the call help signal in five seconds.

After the call help signal is sent out, the **Call Help** quick key flashes in red. If you need to stop calling for help, select the **Call Help** quick key again.

Monitors receiving the call help signal issue a sound and a dialog box pops up indicating which monitor is calling. Select **OK** to acknowledge the call and stop the sound at this monitor.

The CMS receiving the call help signal also issues a sound which automatically stops after a while. Selecting the call help icon on the CMS clears this call help and stops the sound.

NOTE

- The call help function works only when the monitor is connected to the network.
 - The call help sound may disturb animals in the same department.
-

7.11 CPB Mode

In the CPB (Cardiopulmonary Bypass) mode, all the physiological alarms and technical alarms are switched off. So when performing CPB, you can put the monitor in the CPB mode in order to inactivate unnecessary alarms.

7.11.1 Entering the CPB Mode

To enter the CPB mode, choose either of the following ways:

- Select the **CPB Mode** quick key.
- Select the **Main Menu** hard key or quick key → from the **Alarm Setup** column select **Setup**→ **CPB Mode**.

In the CPB mode, **CPB Mode** is displayed in the physiological alarm area with a red background color.

NOTE

- When the CPB mode is entered, the monitor stops all NIBP measurements. You can restart NIBP measurements after entering the CPB mode.
-

7.11.2 Exiting the CPB Mode

To exit the CPB mode, choose either of the following ways:

- Select the **CPB Mode** quick key.
- Select the **Main Menu** hard key or quick key → from the **Alarm Setup** column select **Setup**→ **Exit CPB Mode**.

7.12 Intubation Mode

Intubation mode is available for Resp, CO₂ monitoring. When performing intubation during general anesthesia, you can put the monitor in the intubation mode in order to inactivate unnecessary alarms.

In the intubation mode, Resp, CO₂ related physiological alarms are switched off.

7.12.1 Entering the Intubation Mode

To enter the intubation mode, choose either of the following ways:

- Select the **Intubation Mode** quick key.
- From the bottom of the **Resp** or **CO₂** menu, select **Intubation Mode**.
- Select the **Main Menu** hard key or quick key → from the **Alarm Setup** column select **Setup**→ **Intubation Mode**.

7.12.2 Exiting the Intubation Mode

To exit the intubation mode, choose either of the following ways:

- Select the **Exit Intubation Mode** quick key.
- From the bottom of the **Resp** or **CO₂** menu, select **Exit Intubation Mode**.
- Select the **Main Menu** hard key or quick key → from the **Alarm Setup** column select **Setup**→ **Exit Intubation Mode**.

7.13 Testing Alarms

The monitor automatically performs a selftest at startup. Check that an alarm tone is heard, and the alarm lamp illuminates, one by one, in red, yellow. This indicates that audible and visible alarm indicators function properly.

7.14 Actions When an Alarm Occurs

When an alarm occurs, observe the following steps and take proper actions:

1. Check the animal's condition.
2. Confirm the alarming parameter or alarm category.
3. Identify the source of the alarm.
4. Take proper action to eliminate the alarm condition.
5. Make sure the alarm condition is corrected.

For more information, see *D Alarm Messages*.

8

Monitoring ECG, Arrhythmia, ST and QT

8.1 ECG Introduction

The electrocardiogram (ECG) measures and records the electrical activity of the heart. ECG monitoring provides 3-lead and 5-lead ECG monitoring, ST-segment analysis, arrhythmia analysis, and QT/QTc measurements.

8.2 ECG Safety Information

WARNING

- This equipment is not intended for direct cardiac application.
 - Make sure the conductive parts of electrodes and associated connectors, including the neutral electrode, do not contact any other conductive parts including earth.
 - Use defibrillation-proof ECG cables during defibrillation.
 - Do not touch the animal or metal devices connected to the animal during defibrillation.
 - To reduce the hazard of burns during high-frequency surgical procedure, ensure that the monitor's cables and transducers never come into contact with the electrosurgery unit (ESU).
 - To reduce the hazard of burns during use of high-frequency surgical unit (ESU), the ECG electrodes should not be located between the surgical site and the ESU return electrode.
 - Never entangle the ESU cable and the ECG cable together.
 - If the ESU is used, do not place ECG electrodes near the grounding plate of the ESU. Otherwise interference on ECG signals may occur.
 - For the details about esophageal ECG probe and its precautions, see its Instructions for Use.
-

CAUTION

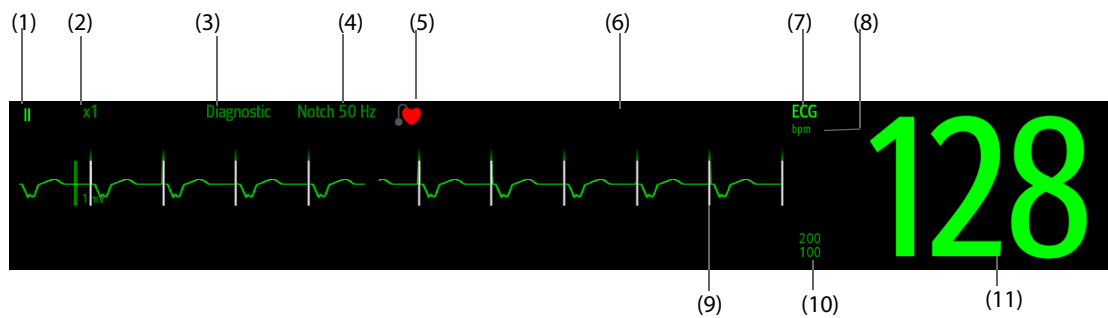
- Only use parts and accessories specified in this manual. Follow the instructions for use and adhere to all warnings and cautions.
 - Periodically inspect the electrode application site to ensure skin integrity. If the skin quality changes, replace the electrodes or change the application site.
 - Interference from ungrounded instrument near the animal and electrosurgery interference can induce noise and artifact into the waveforms.
-

NOTE

- Store the electrodes at room temperature.
 - Immediately use the electrode after open the its package.
 - Never mix animal electrode types or brands. This may lead to problem due to impedance mismatch.
 - When applying the electrodes, avoid bony area, obvious layers of fat, and major muscles. Muscle movement can result in electrical interference. Applying electrodes on major muscles, for example on muscles of the thorax, may lead to erroneous arrhythmia alarms due to excessive muscle movement.
-

8.3 ECG Display

The following figure shows the ECG waveform and numeric areas.



(1) ECG lead label of the displayed waveform.

(2) ECG waveform gain

(3) ECG filter mode

(4) Notch filter status

(5) Paced status:

If **Paced** is set to **Yes**,  is displayed. If **Paced** is set to **No**,  is displayed.

(6) HR/PR alarm message

(7) Parameter label

(8) HR unit

(9) Pace pulse mark:

If **Paced** is set to **Yes**, the pace pulse markers "|" are displayed corresponding to detected pace pulse on each ECG waveform.

(10) HR alarm limits

(11) HR value

8.4 ECG Monitoring (for Limb Lead)

8.4.1 Monitoring Procedure

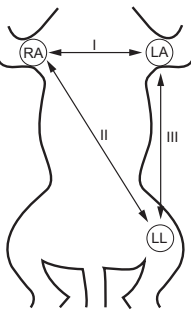
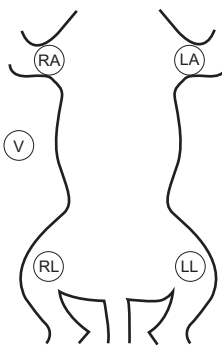
To prepare the ECG measurement, follow this procedure:

1. Connect the electrode cable to ECG connector on the monitor.
2. Prepare the Animal's Skin.

Proper skin preparation is necessary for good signal quality at the electrode, as the skin is a poor conductor of electricity. To properly prepare the skin, choose flat areas and then follow this procedure:

- a. Shave hair from skin at chosen sites.
 - b. Gently rub skin surface at sites to remove dead skin cells.
 - c. Thoroughly cleanse the site. It is not recommend using ether or pure alcohol, because this dries the skin and increases the resistance.
 - d. Dry the skin completely before applying the electrodes.
3. Attach the clips or snaps to the electrodes before placing them.

4. Apply the electrodes to the animal. electrode placement is illustrated using the AHA naming convention

3-Leadwire Electrode Placement	 • RA placement: on the right foreleg. • LA placement: on the left foreleg. • LL placement: on the left hind leg.
5-Leadwire Electrode Placement	 • RA placement: on the right foreleg. • LA placement: on the left foreleg. • RL placement: on the right hind leg. • LL placement: on the left hind leg. • V (precordial) lead: exploring lead.
Lead Placement for Surgical Animals	The surgical site should be taken into consideration when placing electrodes on a surgical animal. • For open-chest surgery: the chest electrodes can be placed on the lateral chest or back. • For using the electrosurgical units: place the limb electrodes close to the shoulders and lower abdomen and the chest electrodes on the left side of the mid-chest. Do not place the electrodes on the upper arm. Otherwise, the ECG waveform will be very small.
Lead Placement for Pacemaker Animals	The pacemaker animal usually requires a different electrode placement configuration than a non-pacemaker animal. Do not place an ECG electrode directly over the pacemaker generator. Place the electrodes 5 cm to 7 cm away from the pacemaker generator area. For example, if the pacemaker generator is located in the left subclavian area, relocate the Left Arm electrode closer in towards the center of the chest.

4. Adjust parameters in the **ECG** menu to obtain the optimized waveform display.

8.4.2 Lead Wire Color Code

The following table lists the color coding of leadwires for both AHA and IEC standards:

Lead	IEC		AHA	
	Label	Color	Label	Color
Right foreleg	R	Red	RA	White
Left foreleg	L	Yellow	LA	Black
Right hind leg	N	Black	RL	Green
Left hind leg	F	Green	LL	Red

8.4.3 Choosing the ECG Lead Type

To choose ECG lead type, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** menu.
2. Select the **Setup** tab.

3. Set **Lead Set** according to the lead type you are going to use. The default lead type is **Auto**. In this case, the monitor automatically detects the lead type.

8.4.4 Checking Paced Status

You should check the animal's paced status before monitoring ECG. The paced symbol  is displayed when **Paced** is set to **Yes**. The pace pulse markers “|” are shown on each ECG waveform when the animal has a paced signal. If **Paced** is set to **No** or if the animal's paced status is not selected, the symbol  will be shown in the ECG waveform area.

To change the paced status, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** menu.
2. Select the **Pacer** tab.
3. Set **Paced** to **Yes** or **No**.

If you did not set the paced status, the monitor issues a prompt tone when pace pulse is detected. At the same time, the paced symbol  flashes and the message **Please check if the patient has a pacemaker.** appears in the ECG waveform area. Check and set the animal's paced status.

WARNING

- For paced animals, set **Paced** to **Yes**. Otherwise the monitor could mistake a pace pulse for a QRS complex and fail to generate alarm when the ECG signal is too weak. On ventricular paced animals, episodes of ventricular tachycardia may not always be detected. Do not rely entirely upon the system's automated arrhythmia detection algorithm.
 - False low heart rate or false asystole alarms may result with certain pacemakers because of pacemaker artifacts, such as electrical overshoot of the pacemaker overlapping the true QRS complexes.
 - Do not rely entirely on rate meter alarms when monitoring animals with pacemakers. Always keep these animals under close surveillance.
 - For non-paced animals, you must set **Paced** to **No**.
-

8.4.5 Enabling Pacer Rejection

The pace pulse rejection function is disabled by default. To enable this function, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** menu.
2. Select the **Pacer** tab.
3. Switch on **Pacer Reject**.

NOTE

- When pace pulses are detected, the pace pulse marks “|” are shown on the ECG waveforms. **Pacer Rejection** setting has no impact on the display of pace pulse marks “|”.
 - You can switch on **Pacer Reject** only when **Paced** is set to **Yes**. If **Paced** is set to **No**, the setting of **Pacer Reject** is disabled.
-

8.5 ECG Monitoring (for Esophageal Lead)

NOTE

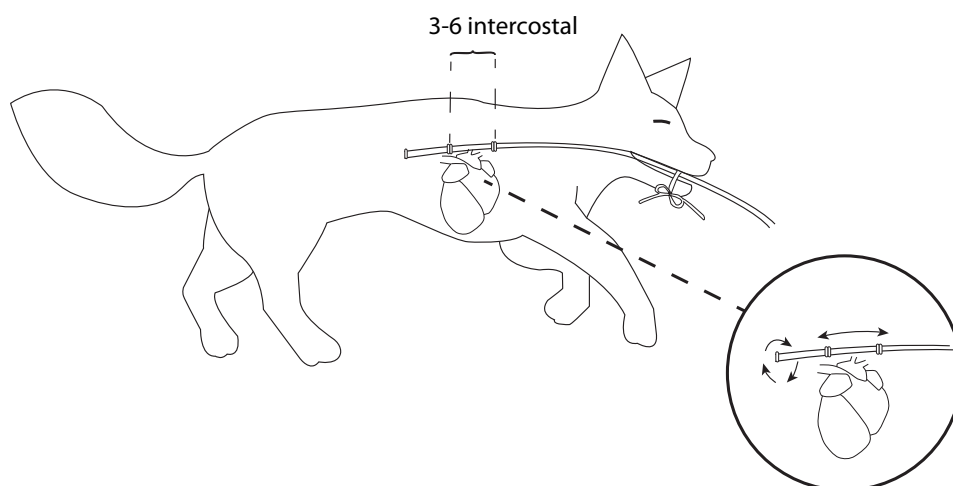
- When **Esophageal** is set to **Yes**, the ECG cannot be used as the source of RR.
 - When **Esophageal** is set to **Yes**, the **Resp** parameter is switched off and cannot be switched on.
-

To measure the ECG of the esophageal position, follow this procedure:

1. Connect the electrode cable to ECG connector on the monitor.

2. Select ECG parameter area or waveform area to enter **ECG** menu→Select the **Setup** tab→set **Esophageal** to **Yes**.
3. Apply sufficient water to the probe.
4. Insert the probe into esophagus through mouth.

Place the probe to optimal measurement position. The probe should be placed neither too deep nor too shallow, otherwise, the ECG measurement may be incorrect. To obtain a better ECG signal, locate the heart area (3-6 intercostal) between the two electrometal leads. Before placing the probe, the depth of the probe should be estimated outside the animal to avoid the depth exceeding the chest cavity.



5. Fix the probe to the mandible of the animal with gauze.
6. Adjust parameters in the **ECG** menu to obtain the optimized waveform display.

8.6 Changing ECG Settings

8.6.1 Choosing an ECG Screen

When monitoring ECG, you can choose the screen as desired.

- For 3-lead ECG monitoring, only normal screen is available.
- For 5-lead ECG monitoring, besides the normal screen, you can also choose 7-lead full screen or 7-lead half screen.

To choose the desired screen configuration, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** menu.
2. From the bottom of the menu, select **Full-Screen**, or **Half-Screen**.

8.6.2 Setting ECG Alarm Properties

To set ECG alarm properties, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** menu.
2. Select the **Alarm** tab.
3. Input the password if required.
4. Set alarm properties as desired.

8.6.3 Setting the Analysis Mode

Multiple leads analysis enhances detection sensitivity and reduces false alarms. However, when most leads are noisy or with low amplitude, choosing the optimal lead as calculation lead and single lead analysis is recommended.

To set the ECG analysis mode, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** menu.

2. Select the **Setup** tab.
3. Set the **Analysis Mode**.
 - ◆ **Multiple Leads:** the monitor uses two leads (ECG1 to ECG 2) as calculation leads.
 - ◆ **Single Lead:** the monitor uses one lead (ECG1) as calculation lead.

NOTE

- **It is difficult for the monitor to differentiate an aberrantly conducted beat from a ventricular beat. An aberrantly conducted beat may be misclassified as a ventricular beat. In this case, choose the lead with a narrow R-wave for ECG1 and select Single Lead.**
 - **When a 3-lead ECG cable is used, the monitor always uses single lead as calculation lead.**
-

8.6.4 Changing ECG Wave Settings

8.6.4.1 Selecting the Leads of Displayed ECG Waveforms

To select the leads of displayed ECG waveforms, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** menu.
2. Select the **Setup** tab.
3. Select **ECG** to set the lead of each ECG waveform.
4. If more than three ECG waveforms are displayed, select the **More Leads** tab, and then select **ECG** to set leads of other ECG waveforms.

The waveform of selected lead should have the following characteristics:

- The QRS complex is tall and narrow.
- The QRS complex is completely above or below the baseline. It should not be biphasic.
- The amplitudes of P waves and T waves are less than 0.2 mV.

CAUTION

- **Ensure that you have selected the optimal leads with the best waveform amplitude and the highest signal-to-noise ratio. Selecting the optimal leads is important for detecting beats, classifying beats, and detecting ventricular fibrillation.**
-

8.6.4.2 Setting the ECG Waveform Layout

To set the ECG waveform layout, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** menu.
2. Select the **Setup** tab.
3. Set **Waveform Layout**.
 - ◆ **Standard:** the waveform sequence is I, II, III, aVR, aVL, aVF, V.
 - ◆ **Cabrera:** the waveform sequence is aVL, I, -aVR, II, aVF, III, V.

8.6.4.3 Changing ECG Waveform Size

If the ECG waveform is too small or clipped, you can change its size by selecting an appropriate **Gain** setting. To do so, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** menu.
2. Select the **Setup** tab.
3. Select **ECG Gain** to set the size of each ECG waveform.
4. If more than three ECG waveforms are displayed, select the **More Leads** tab, and then select **ECG Gain** to change the sizes of other ECG waveforms. If you select **Auto**, the monitor automatically adjusts the size of the ECG waveforms.

8.6.4.4 Changing ECG Waveform Speed

To change ECG waveform speed, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** menu.
2. Select the **Setup** tab.
3. Set **Speed**.

8.6.4.5 Setting the ECG Filter

To set the ECG waveform filter mode, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** menu.
2. Select the **Setup** tab.
3. Set **Filter**.
 - ◆ **Diagnostic**: is used when ECG waveform of diagnostic quality is required.
 - ◆ **Monitor**: is used in ECG monitoring.
 - ◆ **Surgery**: is used if ECG signals are distorted by high or low frequency noise. In the operating room, setting **Filter** to **Surgery** can reduce ESU interference. However, during normal ECG monitoring, selecting **Surgery** may suppress certain features or details of the QRS complexes.
 - ◆ **ST**: is recommended for ST monitoring.
 - ◆ **Emphasis**: is used when ECG signals are still obviously distorted by high or low frequency noise when selecting **Surgery**. However, during normal ECG monitoring, selecting **Emphasis** may suppress certain features or details of the QRS complexes.
 - ◆ **Custom**: is used to customize filter frequency range including **Highpass** and **Lowpass**. Signal within this range is displayed and signal beyond this range is filtered out. For example, set **Highpass** and **Lowpass** as **0.32Hz** and **45Hz** respectively, then signal with frequency between 0.32Hz and 45Hz is displayed and signal with frequency beyond 0.32Hz and 45Hz is filtered out.

8.6.4.6 Switching On or Off the Notch Filter

The notch filter removes the line frequency interference. To switch on or off the notch filter, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** menu.
2. Select the **Setup** tab.
3. Switch on or off **Notch Filter**.

NOTE

- **Notch Filter can only be switched on or off when Filter is set to Diagnostic. In other filter modes, Notch Filter is always on.**

8.6.5 Disabling the Smart Lead Off Function

The monitor provides the smart lead off function. When the lead of the first ECG wave is detached but another lead is available, the monitor automatically switches to the available lead to recalculate heart rate, and to analyze and detect arrhythmias. When you reconnect the detached leads, the monitor automatically switches back to the original lead.

The smart lead off function is enabled by default. To disable this function, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** menu.
2. Select the **Setup** tab.
3. Switch off **Smart Lead**.

8.6.6 Adjusting the QRS Volume

To adjust the QRS volume, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** menu.
2. Select the **Setup** tab.
3. Set **QRS Volume**.

When valid SpO₂ measurements are available, the monitor adjusts the pitch of QRS tone based on the SpO₂ value.

8.6.7 Adjusting the Minimum QRS Detection Threshold

To avoid false asystole alarm due to low R wave amplitude, and to avoid tall T waves and P waves being mistaken for QRS complexes, the monitor provides a means to manually adjust the minimum QRS detection threshold.

To adjust the minimum QRS detection threshold, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** menu.
2. Select the **Setup** tab and set **Filter** to **Monitor**.
3. Select the **QRS Threshold** tab.
4. Select up or down arrow buttons to adjust the minimum threshold for QRS detection. Selecting **Default** resets the QRS threshold to the default value (0.16 mV).

CAUTION

- The setting of the QRS detection threshold can affect the sensitivity for arrhythmia, ST, QT/QTc detection, and heart rate calculation.
 - If QRS amplitude is low, the monitor might not be able to calculate heart rate and false asystole calls may occur.
-

NOTE

- The minimum QRS detection threshold can only be adjusted when the ECG filter is set to Monitor.
-

8.7 Monitoring Arrhythmia

8.7.1 Arrhythmia Safety Information

WARNING

- Heart rate reading may be affected by cardiac arrhythmias. Do not rely entirely on heart rate alarms when monitoring animals with arrhythmia. Always keep these animals under close surveillance.
 - The arrhythmia analysis program may incorrectly identify the presence or absence of an arrhythmia. Therefore, a physician must analyze the arrhythmia information with other clinical findings.
-

CAUTION

- Since the arrhythmia detection algorithm sensitivity and specificity are less than 100%, sometimes there may be some false arrhythmias detected and also some true arrhythmia events may not be detected. This is especially true when the signal is noisy.
 - The ECG size and minimum QRS detection threshold settings affect arrhythmia detection and heart rate calculation sensitivity.
 - If QRS amplitude is low, the monitor might not be able to calculate heart rate and false asystole calls may occur.
 - During the learning phase of the algorithm, arrhythmia detection may not be available. To allow the algorithm to reach optimal detection performance, you should closely monitor animal condition during learning phase and for several minutes after the learning phase.
-

8.7.2 Arrhythmia Events

This section lists all arrhythmia events and their criteria.

8.7.2.1 Lethal Arrhythmia Events

Arrhythmia message	Description
Asystole	No QRS complex detected within the set time interval in the absence of ventricular fibrillation or chaotic signal.
V-Fib/V-Tach	A fibrillatory wave for 6 consecutive seconds. A dominant rhythm of adjacent PVCs and the ventricular rate is greater than the V-tach rate limit.
V-Tach	The number of consecutive PVCs is greater than or equal to the V-Tach PVCs limit, and the ventricular rate is greater than or equal to the V-Tach rate limit.
Vent Brady	The number of consecutive PVCs is greater than or equal to V brady PVC limit and the ventricular rate is less than the V brady rate limit.
Extreme Tachy	The heart rate is greater than the extreme tachycardia limit.
Extreme Brady	The heart rate is less than the extreme bradycardia limit.

8.7.2.2 Nonlethal Arrhythmia Events

Arrhythmia message	Description
R on T	R on T PVC is detected.
Run PVCs	More than two consecutive PVCs, but lower than the V brady PVCs limit, and the ventricular rate is lower than the V-Tach rate limit.
Couplet	A Pair of PVCs detected in between normal beats.
Multiform PVC	Multiform PVCs detected in Multif. PVC's Window (which is adjustable).
PVC	One PVC detected in between normal beats.
Bigeminy*	A dominant rhythm of N, V, N, V, N, V.
Trigeminy*	A dominant rhythm of N, N, V, N, V, N, V, N, V.
Tachy	The heart rate is greater than the tachycardia limit.
Brady	The heart rate is lower than the bradycardia limit.
Pacer Not Capture	No QRS complex detected for 300 ms following a pace pulse (for paced animals only).
Pacer Not Pacing	No pace pulse detected for 1.75 x average R-to-R intervals following a QRS complex (for paced animals only).
Missed Beat	At least 3 consecutive Ns, and The current RR interval is greater than 1.5 x previous RR interval, and The next RR interval is lower than 1.5 x average RR interval, and HR lower than 100 and the current RR interval is greater than 1.75 x average RR interval , or HR is greater than or equal to 100 and the current RR interval is greater than 1000 ms.
Nonsus V-Tach	The number of consecutive PVCs is lower than the V-Tach PVCs limit but greater than 2, and the ventricular rate is greater than or equal to the V-Tach Rate limit.
Vent Rhythm	The number of consecutive PVCs is greater than or equal to the V Brady PVCs limit, and ventricular rate is greater than or equal to the V Brady Rate limit but lower than V-Tach Rate limit.
Pause	No QRS complex is detected within the set time threshold of pause.

Arrhythmia message	Description
Irr Rhythm	Consistently irregular rhythm (N, irregular RR interval change is greater than 12.5%)
PVCs/min	PVCs/min exceeds high limit.
Pauses/min	Pauses/min exceeds high limit.
SVT	The number of consecutive SVCs is greater than or equal to the SVT SVCs limit, and the supraventricular HR is greater than or equal to the SVT HR limit.
SVCs/min	SVCs/min exceeds the high limit.

*N: normal beat; V: ventricular beat

8.7.3 Displaying Arrhythmia Information

You can display the arrhythmia information in the numeric area. To do so, follow this procedure:

1. Access **Tile Layout** by either of the following ways:
 - ◆ Select the **Screen Setup** quick key → select the **Tile Layout** tab.
 - ◆ Select **Main Menu** hard key or quick key → from the **Screen Setup** column select **Tile Layout**.
2. Click the numeric area where you want to display the arrhythmia information, and then select ECG → **Arrhythmia**.

8.7.4 Changing Arrhythmia Settings

8.7.4.1 Changing Arrhythmia Alarm Settings

To set the arrhythmia alarm properties, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** menu.
2. Select the **Arrhythmia** tab→ **Alarm** tab.
3. Input the password if required.
4. Set alarm properties as desired.

NOTE

- You can switch off lethal arrhythmia alarms only when you have enabled Lethal Arrhys Off. For more information, see 8.7.4.2 *Setting the Lethal Arrhythmia Alarms Switch*.
- The priority of lethal arrhythmia alarms is always high. It cannot be altered.

8.7.4.2 Setting the Lethal Arrhythmia Alarms Switch

You can choose whether switching off lethal arrhythmia alarms is permissible or not. This function is password protected. For more information, see 20.5.5 *The Other Tab*.

WARNING

- If you switch off all arrhythmia alarms, the monitor will not alarm for any arrhythmia event. This may result in a hazard to the animal. Always keep the animal under close surveillance.

NOTE

- If any of the lethal arrhythmia alarms is switched off, the ECG waveform area displays the “Lethal Arrhys Off” message.

8.7.4.3 Changing Arrhythmia Alarm Threshold Settings

You can change threshold settings for some arrhythmia alarms. When an arrhythmia violates its threshold, an alarm will be triggered. To do so, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** menu.
2. Select the **Arrhythmia** tab → select the **Threshold** tab.
3. Input the password if required.
4. Set the threshold of desired arrhythmia alarms.

NOTE

- **The asystole delay time relates to ECG relearning. When heart rate is less than 30 bpm, it is recommended to set Asystole Delay to 10 sec.**

8.7.4.4 Arrhythmia Threshold Range

Arrhythmia	Threshold Range
Asystole Delay	3s to 10s
Tachy(HR High)	60 to 295 bpm
Brady(HR Low)	16 to 120 bpm
Extreme Tachy	65 to 300 bpm
Extreme Brady	15 to 115 bpm
Multif PVCs Window	3 to 31 beats
V-Tach Rate	100 to 200 bpm
V-Brady Rate	15 to 60 bpm
V-Tach PVCs	3 to 99 beats
V-Brady PVCs	3 to 99 beats
Pauses/min	1 to 15
Pause Threshold	1.5s, 2.0s, 2.5s, 3.0s
SVT HR	100 to 300 bpm
SVT SVCs	3 to 99 beats
SVCs/min	1 to 100
Refractory Period 1	Off, 30s, 1 min, 2 min, 3 min, 4 min, 5 min
Refractory Period 2	Off, 30s, 1 min, 2 min, 3 min, 4 min, 5 min, 10 min, 15 min

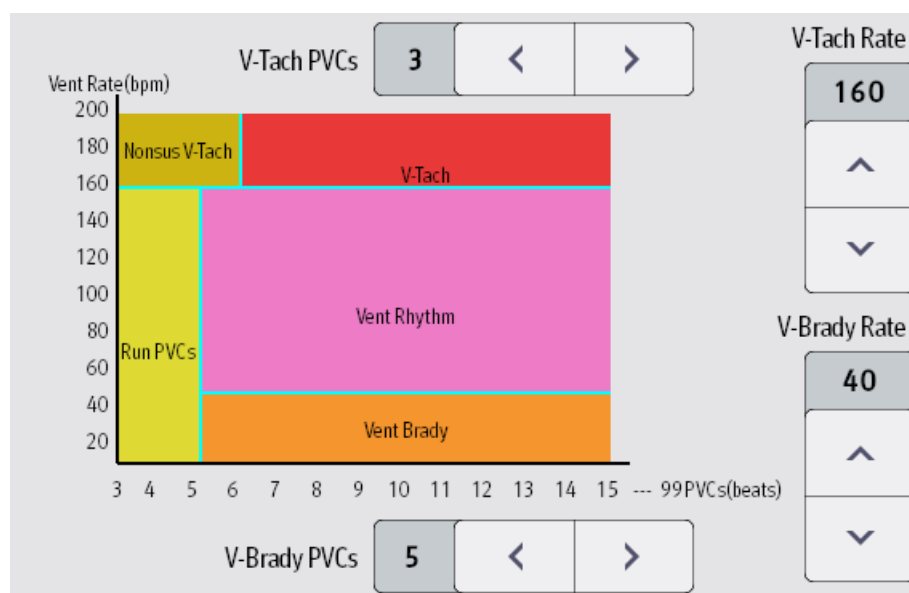
8.7.4.5 Setting Thresholds for PVC-Related Alarms

The monitor detects PVC-related alarms basing on the current PVC rate and the number of consecutive PVCs.

To set the required thresholds for PVC-related alarms, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** menu.
2. Select the **Arrhythmia** tab → select the **More Threshold** tab.
3. Input the password if required.
4. Adjust **V-Tach PVCs**, **V-Tach Rate**, V-Brady PVCs, and V-Brady Rate to set the threshold of desired PVC-related alarms.

The following figure illustrates the conditions under which PVC alarms will be generated if **V-Tach PVCs** is set to 3, **V-Tach Rate** is set to 160, **V-Brady PVCs** is set to 5, and **V-Brady Rate** is set to 40.



- If the number of consecutive PVCs is greater than or equal to the V-Tach PVCs limit (3), and the ventricular rate (Vent Rate) is greater than or equal to the V-Tach Rate limit (160), a V-Tach alarm is generated.
- If the number of consecutive PVCs is lower than the V-Tach PVCs limit (3) but greater than 2, and the ventricular rate is greater than or equal to the V-Tach Rate limit (160), a Nonsus V-Tach alarm is generated.
- If the number of consecutive PVCs is greater than or equal to the V-Brady PVCs limit (5), and the ventricular rate is lower than the V-Tach Rate limit (160) but greater than or equal to the V Brady Rate limit (40), a Vent Rhythm alarm is generated.
- If the number of consecutive PVCs is lower than the V-Brady PVCs limit (5) but greater than 2, and the ventricular rate is lower than the V-Tach Rate limit (160), a Run PVCs alarm is generated.
- If the number of consecutive PVCs is greater than or equal to the V-Brady PVCs limit (5), and the ventricular rate is lower than the V Brady Rate limit (40), a Vent Brady alarm is generated.

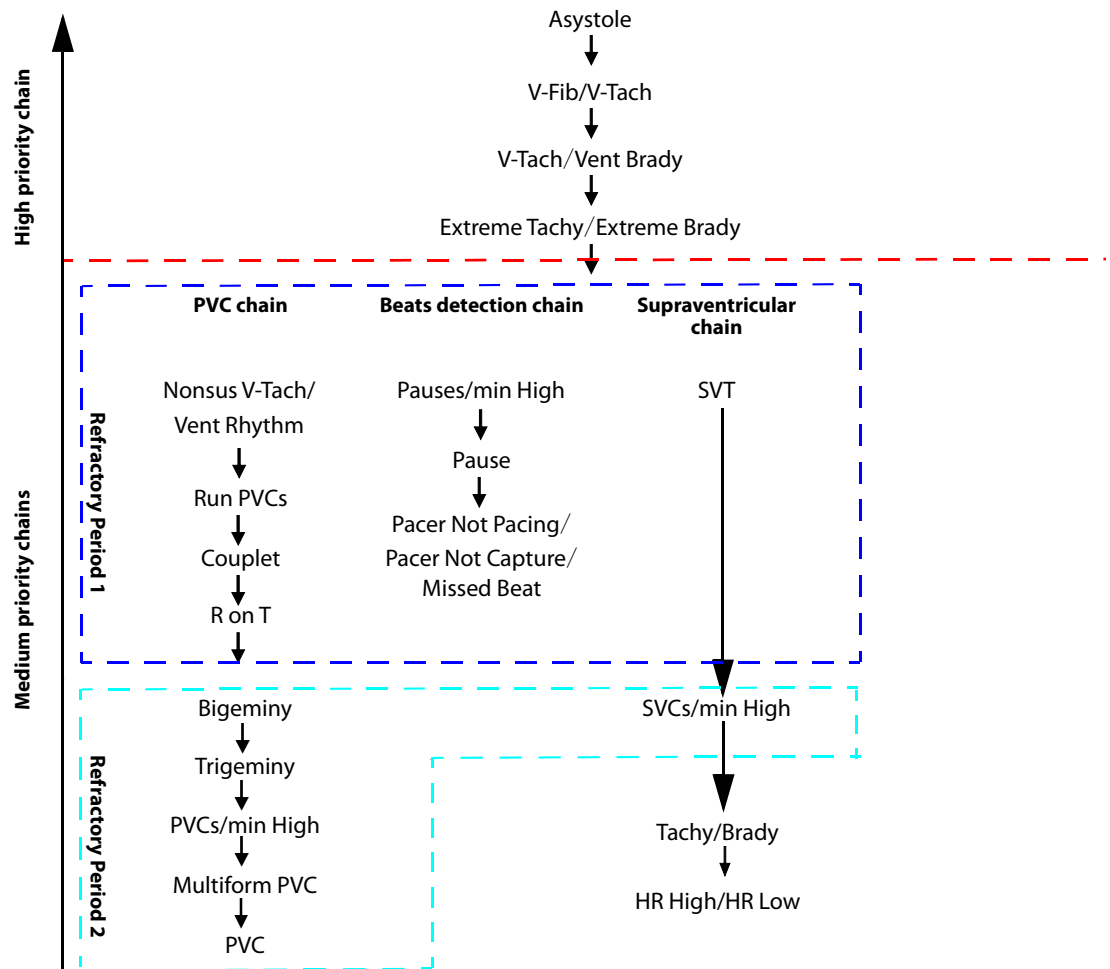
8.7.5 Arrhythmia Alarms

The monitor generally issues an alarm once an arrhythmia condition is detected. However, in some conditions, alarm light and alarm tone are disabled although the arrhythmia condition is detected. For more information, see 8.7.5.1 *Arrhythmia Alarm Chains* and 8.7.5.2 *Setting Arrhythmia Alarm Shielding Period*.

8.7.5.1 Arrhythmia Alarm Chains

If multiple arrhythmia conditions occur simultaneously, announcing all detected alarm conditions may be confusing. This may result in serious conditions being overlooked. So arrhythmia alarms are prioritized through alarm chains.

There are five arrhythmia alarm chains: one high priority chain and four medium priority chains, including PVC chain, beats detection chain, and supraventricular chain.



Note: The refractory periods have no impact on Tachy, Brady, HR High, and HR Low.

8.7.5.2 Setting Arrhythmia Alarm Shielding Period

The arrhythmia algorithm can disable alarm light and alarm tone for designated period of time when certain arrhythmia alarms are detected.

This function is password protected. For more information, see **Arrhy Shield Time** in 20.5.5 *The Other Tab*.

NOTE

- The arrhythmia shielding period is only applicable to arrhythmias in the medium priority chains. For arrhythmias in the high priority chain, alarm tone and alarm light are generated as soon as an alarm condition is detected.
- The arrhythmia shielding period has no impact on HR High, HR Low, Tachy, Brady, and Irr Rhythm End.

8.7.5.3 Arrhythmia Alarm Shielding Rules

The following table explains how audible and visual alarm indicate during arrhythmia alarm shielding period.

Previous alarm	Current alarm	Alarm indication
Alarm in high priority chain	Alarm in high priority chain	Alarm light and alarm tone
	Alarm in medium priority chain	During the shielding period, alarm light and alarm tone are disabled. When the shielding period is reached, alarm light and alarm tone are reactivated.
Alarm in medium priority chain	Alarm in high priority chain	Alarm light and alarm tone
	Alarm in the same medium priority chain, but with higher priority	Alarm light and alarm tone
	The same alarm reoccurs	During the shielding period, alarm light and alarm tone are disabled. When the shielding period is reached, alarm light and alarm tone are reactivated.
	Alarm in the same medium priority chain, but with lower priority	During the shielding period, alarm light and alarm tone are disabled. When the shielding period is reached, alarm light and alarm tone are reactivated.
	Alarm in other medium priority chain	Alarm light and alarm tone

8.7.5.4 Setting Arrhythmia Refractory Periods

For some arrhythmias in the medium priority chain, an arrhythmia and arrhythmias with lower priority in the same alarm chain can be deactivated in a designated period of time. This period is called refractory period. When an arrhythmia is detected, the refractory period automatically starts. During the refractory period, the same alarm condition does not trigger an alarm. If the condition of an arrhythmia with lower priority in the same alarm chain appears, the monitor does not generate an alarm either.

To set arrhythmia refractory periods, follow this procedure:

1. Access arrhythmia alarm setup by either of the following ways:
 - ◆ Select the ECG numeric area or waveform area to enter the **ECG** menu → select the **Arrhythmia** tab.
 - ◆ Select the **Alarm Setup** quick key → select the **Arrhythmia** tab.
2. Select the **Threshold** tab.
3. Set **Refractory Period 1** and **Refractory Period 2**. The default refractory period1 is 3 minutes. The default refractory period2 is 10 minutes. To disable a refractory period, set it to **Off**.

See the figure of arrhythmia alarm chain in 8.7.5.1 *Arrhythmia Alarm Chains* for arrhythmias applying to Refractory Period 1 and Refractory Period 2.

NOTE

- Refractory periods are only applicable to arrhythmias in the medium priority chains.
- Refractory periods have no impact on Tachy, Brady, HR High, HR Low, and Irr Rhythm/Irr Rhythm End.

8.8 ST Segment Monitoring

8.8.1 ST Safety Information

WARNING

- ST values may be affected by such factors as some drugs or metabolic and conduction disturbances.
- ST deviation is often calculated at a fixed offset from the J point. Changes in heart rate may affect ST.
- The significance of the ST segment changes must be decided by the physician.

8.8.2 Enabling ST Monitoring

The ST monitoring function is disabled by default. Before you start ST monitoring, enable the ST function. To do so, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** menu.
2. Select the **ST** tab→ select the **Setup** tab.
3. Switch on **ST Analysis**.

ST analysis may not be reliable under the following situations. Consider switching off ST analysis in these cases:

- The animal is implanted with a ventricular pacemaker.
- The animal has left bundle branch block.
- Arrhythmias such as flutter occur, which may cause irregular baseline.
- All ECG leads are noisy.

8.8.3 Displaying ST Numerics

To display ST numerics and Segments, follow this procedure:

1. Access **Tile Layout** by either of the following ways:
 - ◆ Select the **Screen Setup** quick key → select the **Tile Layout** tab.
 - ◆ Select **Main Menu** hard key or quick key → from the **Screen Setup** column select **Tile Layout**.
2. Click the numeric area where you want to display the ST numerics, and then select **ECG** → **ST**.

The display of ST parameters area is different according to the lead type:

- When you are using the 3-lead ECG leadwires, the ST numeric area does not display. A ST value displays in the ECG numeric area.
- When you are using the 5-lead ECG leadwires, the ST numeric area displays 7 ST values: ST-I, ST-II, ST-III, ST-aVR, ST-aVL, ST-aVF, ST-V.

This example shows the ST numeric area when 5-lead ECG cable is used.



(1) Parameter label.

(2) ST unit

(3) ST alarm off symbol

(4) Lead labels

(5) ST numerics: a positive value indicates ST segment elevation, and a negative value indicates ST segment depression.

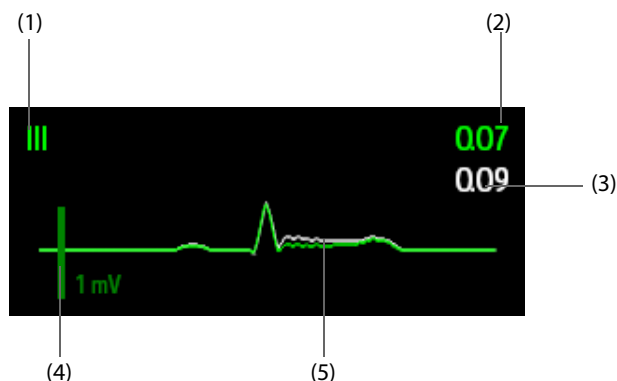
8.8.4 Displaying ST Segments in the Waveform Area

You can display ST segments in the waveform area. To do so, follow this procedure:

1. Access **Tile Layout** by either of the following ways:
 - ◆ Select the **Screen Setup** quick key → select the **Tile Layout** tab.
 - ◆ Select **Main Menu** hard key or quick key → from the **Display** column select **Tile Layout**.

2. Select the waveform area where you want to display the ST segments, and then select **ECG**→ **ST Segment**.

The waveform area displays the current and baseline ST segments. It also displays the current and baseline ST values. In the following picture, the current ST segment and value are in green, while the baseline ST segment and value are in white.



- | | |
|--|----------------------|
| (1) ST lead | (2) Current ST value |
| (3) Baseline ST value | (4) 1 mV scale |
| (5) Current ST segment (green) and baseline ST segment (white) | |

8.8.5 Entering the ST View

The ST View shows a complete QRS segment for each ST lead. The color of current ST segments and ST values is consistent with the color of ECG waveforms, normally green. The color of baseline ST segments and ST values is white.

You can enter the ST view either by selecting the ST segment in the waveform area or by the following ways:

1. Select the ST numeric area, ECG numeric area, or ECG waveform area to enter the **ECG** menu.
2. Select the **ST** tab.
3. From the bottom of the menu, select **ST View**.

8.8.6 Saving the Current ST as Baseline

ST deviation is typically monitored as a relative change from a baseline value. Set an ST baseline when ST values become stable. If you did not set the ST baseline, the monitor automatically saves the baseline when valid ST values appear for 5 minutes. To set the ST baseline, follow this procedure:

1. From the **ST View** window, select **Set Baseline**.
2. From the pop-up dialog box, select **OK** to set the current ST segments and values as the baseline.

From the **ST View** window, you can also perform the following operations:

- Display or hide ST baseline by selecting **Display Baseline** or **Hide Baseline**.
- Display or hide the position of ISO point, J point and ST point by selecting **Display Marker** or **Hide Marker**.

CAUTION

- Updating ST baseline affects ST alarms.
-

8.8.7 Entering the ST Graphic Window

To display **ST Graphic** window, follow this procedure:

1. Select ST numeric area, ECG numeric area, or ECG waveform area to enter the **ECG** menu.
2. Select the **ST** tab.

- From the bottom of the menu, select **ST Graphic**.

When **ST Alarm Mode** is set to **Absolute**. The height of the bar indicates the ST value of corresponding ST lead. The color of the bar indicates ST alarm status: green indicates that corresponding ST value is within alarm limits; yellow and red indicate that the ST value exceeds the alarm limits. The color matches ST alarm priority.

When **ST Alarm Mode** is set to **Relative**. The height of grey bar indicates the baseline ST value and the green bar (yellow or red if an alarm occurs) indicates Δ ST.

8.8.8 Changing ST Settings

8.8.8.1 Setting ST Alarm Properties

To set ST alarm properties, follow this procedure:

- Select the ST numeric area, ECG numeric area, or ECG waveform area to enter the **ECG** menu.
- Select the **ST** tab → **Alarm** tab.
- Set **ST Alarm Mode** to **Absolute** or **Relative**.
 - ◆ **Absolute**: separately set the alarm properties for each ST alarm.
 - ◆ **Relative**: set the alarm properties for **ST Single** and **ST Dual** alarms.
- Set ST alarm properties.

8.8.8.2 Changing Leads for ST Display

The monitor automatically selects the three most deviated leads for ST display. You can also manually select the leads. To do so, follow this procedure:

- Select the ST numeric area, ECG numeric area, or ECG waveform area to enter the **ECG** menu.
- Select the **ST** tab → select the **Setup** tab.
- Set **ST Segment**. You can select up to 3 leads.

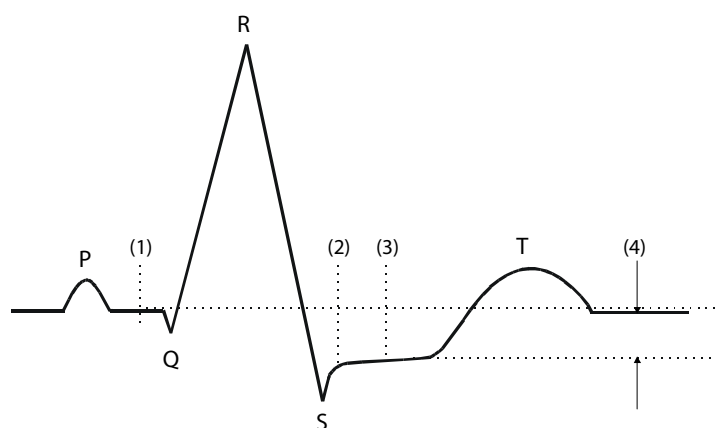
8.8.8.3 Showing ISO Point, J Point, and ST Point Marks

In the waveform area, the ISO point, J point, and ST point mark do not display on the ST segments by default. To show these marks, follow this procedure:

- Select the ST numeric area, ECG numeric area, or ECG waveform area to enter the **ECG** menu.
- Select the **ST** tab → select the **Setup** tab.
- Switch on **Show Markers**.

8.8.9 ST Point, ISO Point, and J Point

The following figure shows the position of ST point, isoelectric (ISO) point, and J point:



- (1) ISO point: is located between the end of the P-wave and the onset of the QRS complex. The ISO point provides the baseline for ST deviation measurement.

- (2) J point: is located at the end of the QRS complex. The distance between the J point and ST point is fixed. So it helps correctly position the ST point.
- (3) ST point: is located at the midpoint of the ST segment.
- (4) ST deviation (ST elevation or depression): is the potential difference between the ISO point and the ST point.

8.8.9.1 Setting ST Point, ISO Point, and J Point

Make sure that the position of the ST point is correctly set for the animal. Incorrect setting of ST point may result in artifactual ST deviation. Adjust the ST point before starting monitoring, or if the animal's heart rate or ECG morphology changes dramatically.

To set ST point, ISO point, and J point, follow this procedure:

1. Select the ST numeric area, ECG numeric area, or ECG waveform area to enter the **ECG** menu.
2. Select the **ST** tab→ select the **Adjust** tab.
3. Set **ST Point**. The ST point is positioned a fixed distance from the J point. When **J+60/80ms** is selected, the ST point is positioned either 80 ms (HR≤120 bpm) or 60 ms (HR>120 bpm) from the J point.

The setting of **Auto Adjust** defines the method of adjusting the ISO point and J point. **Auto Adjust** is enabled by default. In this case, positions of ISO point and J point are automatically adjusted accordingly. If you disable when **Auto Adjust**, you need to manually adjust the position of ISO point and J point by selecting the arrows at the right sides of **ISO** and **J**.

- Put the ISO point in the middle of the flattest part between the P and Q waves.
- Put the J point at the end of the QRS complex and the beginning of the ST segment.

CAUTION

- **Make sure that the position of the ST point is correctly set for the animal. Incorrect setting of ST point may result in artifactual ST deviation. Adjust the ST point before starting monitoring, or if the animal's heart rate or ECG morphology changes dramatically.**
-

8.9 QT/QTc Interval Monitoring

The QT interval is from the beginning of the Q wave to the end of the T wave. QTc is the HR corrected QT interval. Monitoring QT interval helps detect the long QT syndrome.

8.9.1 QT/QTc Monitoring Limitations

Some conditions may make it difficult to achieve reliable QT/QTc monitoring, for example:

- R-wave amplitudes are too low
- The presence of frequent ventricular ectopic beats
- Unstable RR intervals
- P-waves tending to encroach on the end of the previous T-wave at high heart rates
- The T-wave is very flat or T-wave are not well defined
- The end of the T-wave is difficult to delineate because of the presence of U-waves
- QTc measurements are not stable
- In the presence of noise, asystole, ventricular fibrillation, and ECG lead off

For these cases you should select a lead with good T-wave amplitude and no visible flutter activity, and without a predominant U-wave or P-wave.

Some conditions such as left or right bundle branch block or hypertrophy can lead to a widened QRS complex. If a long QTc is observed you should verify it to ensure that it is not caused by QRS widening.

Because normal beats followed by ventricular beats are not included in the analysis, no QT measurement will be generated in the presence of a bigeminy rhythm.

If the heart rate is extremely high, QT will not be measured. When the heart rate changes, it can take several minutes for the QT interval to stabilize. For reliable QTc calculation, it is important to avoid measurements when the heart rate is changing.

8.9.2 Enabling QT/QTc Monitoring

The QT monitoring function is disabled by default. Before you start QT monitoring, enable the QT function. To do so, follow this procedure:

1. Select the QT numerics area, ECG numeric area, or waveform area to enter the **ECG** menu.
2. Select the **QT** tab→ select the **Setup** tab.
3. Switch on **QT Analysis**.

8.9.3 Displaying QT/QTc Numerics and Segments

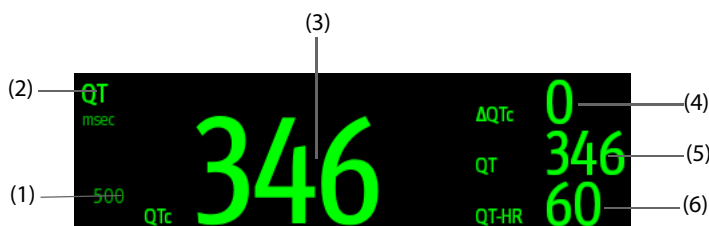
To display QT/QTc numerics and Segments, follow this procedure:

1. Access **Tile Layout** by either of the following ways:
 - ◆ Select the **Screen Setup** quick key → select the **Tile Layout** tab.
 - ◆ Select **Main Menu** hard key or quick key → from the **Display** column select **Tile Layout**.
2. Click the parameter numeric area where you want to display the QT numerics, and then select **ECG** → **QT/QTc**.

NOTE

- **QTc values are calculated based on the QT-HR, not the ECG HR. For more information, see 8.9.4 Entering the QT View.**

The following picture shows the QT numeric area.



- (1) QTc alarm limit (if QTc alarm is off, the alarm off symbol is displayed)
- (2) Parameter label
- (3) QTc value
- (4) ΔQTc value (the difference between the current and baseline QTc values)
- (5) QT value
- (6) QT-HR value

NOTE

- **The display of the QT numeric area differs as related settings change.**

8.9.4 Entering the QT View

QT View shows the current and baseline QT parameter values and waveforms. To enter the QT View, follow this procedure:

1. Select the QT numerics area, ECG numeric area, or waveform area to enter the **ECG** menu.
2. Select the **QT** tab.
3. From the bottom of the menu, select **QT View**.

The following picture shows the QT view.



- The current waveform is shown in the upper half in green.
- The baseline waveform is shown below in white.
- The start of QRS complex and the end of the T wave are marked with a vertical line.
- In some conditions, no QT measurement can be calculated. Then the cause of failed QT measurement is shown at the bottom of the QT numerics area and the message “Cannot Analyze QT” is shown in the technical alarm area.

Select the left or right arrow to switch leads. Corresponding waveform will be highlighted.

8.9.5 Saving the Current QTc as Baseline

In order to quantify differences in the QTc value, you can set a QTc baseline. If you do not set a baseline within the first five minutes after getting valid QT values, the monitor will automatically set a baseline for this animal.

1. From the **QT View** window, select **Set Baseline**.
2. From the pop-up dialog box, select **OK**.

This baseline will then be used to calculate Δ QTc and the old baseline will be discarded.

From the **QT View** window, you can also perform the following operations:

- Select the left or right arrow to select a lead label to highlight corresponding waveform.
- Select **Display Baseline** or **Hide Baseline** to display or hide baseline waveform.

CAUTION

- Updating QTc baseline affects Δ QTc value and alarm.
-

8.9.6 Changing QT Settings

8.9.6.1 Setting QT Alarm Properties

To set QT alarm properties, follow this procedure:

1. Select the QT numerics area, ECG numeric area, or ECG waveform area to enter the **ECG** menu.
2. Select the **QT** tab→ select the **Alarm** tab.
3. Set QTc and Δ QTc alarm properties.

8.9.6.2 Selecting Leads for QT Calculation

You can select one lead or all leads for QT calculation. To do so, follow this procedure:

1. Select the QT numerics area, ECG numeric area, or ECG waveform area to enter the **ECG** menu.
2. Select the **QT** tab→ select the **Setup** tab.
3. Set **QT Leads**. All is selected by default. This means all leads are used for QT calculation.

8.10 ECG Relearning

Changes in ECG template could result in incorrect arrhythmia alarms and/or inaccurate heart rate. ECG relearning allows the monitor to learn new ECG template so as to correct arrhythmia alarms and HR value. Once learning is complete, the dominant QRS complex is stored as a reference template. The reference template is used as a normal morphology of that animal and it is compared with incoming beats to identify possible arrhythmias.

8.10.1 Auto ECG Relearning

Auto arrhythmia relearning happens in the following situation:

- The ECG lead type or lead label is changed.
- ECG leads are off and are not reconnected within 60 seconds.
- The animal's paced status is changed.

8.10.2 Manually Initiating an ECG Relearning

If you suspect that abnormal arrhythmia alarms are presented, you may need to manually initiate an ECG relearning. To do so, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** menu.
2. Select **Relearn** at the bottom left corner of the menu.

CAUTION

- **Initiate ECG relearning only during periods of predominantly normal rhythm and when ECG signal is relatively free of noise. If ECG relearning occurs during arrhythmia, abnormal QRS complex may be incorrectly learned as normal QRS complex, resulting in missed detection of subsequent arrhythmia.**
-

8.11 Calibrating ECG

The ECG signal may be inaccurate due to hardware or software problems. As a result, the ECG waveform amplitude becomes greater or smaller. In that case, you need to calibrate the ECG module. For more information, see 20.6.1 *The ECG Tab*.

8.12 Defibrillation Synchronization Pulse Output

The monitor provides an analog out connector to output defibrillation synchronization pulse. If a defibrillator is connected, it receives a synchronization pulse (100 ms, +5 V) through the analog out connector each time an R-wave is detected.

WARNING

- **Improper use of a defibrillator may cause injury to the animal. The operator should determine whether to perform defibrillation or not according to the animal's condition.**
 - **Before defibrillation, the user must ensure both defibrillator and monitor have passed the system test and can be safely used together.**
-

8.13 ECG Troubleshooting

This section lists the problems that might occur. If you encounter problems when using the monitor or accessories, check the table below before requesting for services. If the problem persists after you have taken corrective actions, contact the Customer Service Department or your local distributor.

Problem	Corrective Actions
Do not see ECG numeric area or waveform area on the main screen	1. Check that ECG is set to display in the Screen Setup menu. For more information, see <i>4.4.1 Configuring the Normal Screen</i>. 2. Check that if the ECG parameter switch is enabled. If not, enable the ECG measurement. For more information, see <i>4.3 General Settings</i>. 3. Check that the cable connections of ECG electrode and the lead set are tight. Replace the ECG electrode or the lead set if needed.
Noisy ECG traces	1. Check that electrodes are not detached or dry. Replace with fresh and moist electrodes if necessary. 2. Check that leadwires are not defective. Replace leadwires if necessary. 3. Check that animal cable or leadwires are routed too close to other electrical devices. Move the animal cable or leadwires away from electrical devices.
Excessive electrosurgical Interference	Use ESU-proof ECG cables.
Muscle Noise	Inadequate skin preparation, tremors, tense subject, and/or poor electrode placement. 1. Perform skin preparation again and re-place the electrodes. For more information, see <i>8.4.1 Monitoring Procedure</i>. 2. Apply fresh, moist electrodes. Avoid muscular areas.
Intermittent Signal	1. Check that cables are properly connected. 2. Check that electrodes are not detached or dry. Perform skin preparation again as described in <i>8.4.1 Monitoring Procedure</i> and apply fresh and moist electrodes. 3. Check that the animal cable or leadwires are not damaged. Change them if necessary.
Excessive alarms: heart rate, lead fault	1. Check that electrodes are not dry. Perform skin preparation again and re-place the electrodes. For more information, see <i>8.4.1 Monitoring Procedure</i>. 2. Check for excessive animal movement or muscle tremor. Reposition the electrodes. Replace with fresh and moist electrodes if necessary.
Low Amplitude ECG Signal	1. Check that the ECG gain is not set too low. Adjust the gain as required. For more information, see <i>8.6 Changing ECG Settings</i>. 2. Perform skin preparation again and re-place the electrodes. For more information, see <i>8.4.1 Monitoring Procedure</i>. 3. Check electrode application sites. Avoid bone or muscular area. 4. Check that electrodes are not dry or used for a prolonged time. Replace with fresh and moist electrodes if necessary.
No ECG Waveform	1. Check that the ECG gain is not set too low. Adjust the gain as required. For more information, see <i>8.6.4 Changing ECG Wave Settings</i>. 2. Check that the leadwires and animal cables are properly connected. 3. Change cable and lead wires. 4. Check that the animal cable or leadwires are not damaged. Change them if necessary.
Base Line Wander	1. Check for excessive animal movement or muscle tremor. Secure leadwires and cable. 2. Check that electrodes are not detached or dry and replace with fresh and moist electrodes if necessary. For more information, see <i>8.4.1 Monitoring Procedure</i>. 3. Check for ECG filter setting. Set ECG Filter mode to Monitor to reduce baseline wander on the display.

9 Monitoring Respiration (Resp)

9.1 Resp Introduction

Impedance respiration is measured across the thorax. When the animal is breathing or ventilated, the volume of air changes in the lungs, resulting in impedance changes between the electrodes. Respiration rate (RR) is calculated from these impedance changes, and a respiration waveform appears on the monitor screen.

9.2 Resp Safety Information

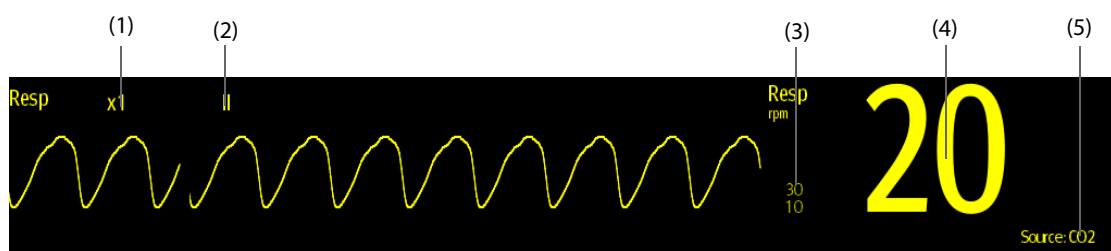
WARNING

- When monitoring the animal's respiration, do not use ESU-proof ECG cables. The respiration measurement does not recognize the cause of apneas. It only indicates an alarm if no breath is detected when a pre-adjusted time has elapsed since the last detected breath. Therefore, it cannot be used for diagnostic purpose.
- The impedance respiration measurement may cause rate changes in Minute Ventilation Rate Responsive Pacemakers. Set the pacemaker rate responsive mode off or disable the impedance respiration measurement on the monitor.
- When using the electrosurgery unit, ensure proper contact of the ESU return electrode to the animal to avoid burns at monitor measurement sites. Also ensure that the ESU return electrode is near the operating area.

CAUTION

- Only use parts and accessories specified in this manual.
- Respiration monitoring is not for use on the animals who are very active, as this will cause false alarms.

9.3 Resp Display



- | | | |
|---------------------------|---------------------|------------------|
| (1) Resp waveform gain | (2) Resp lead label | (3) Alarm limits |
| (4) Respiration rate (RR) | (5) RR source | |

NOTE

- If ESU-proof ECG cables are used, the Resp waveform area will display the message "Check Leads". Replace the ECG cable if necessary.

9.4 Preparing for Resp Monitoring

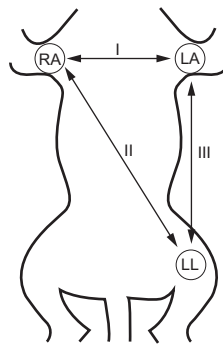
As the Respiration measurement adopts the standard ECG electrode placement, you can use different ECG cables. Since the respiration signal is measured between two ECG electrodes, if a standard ECG electrode placement is applied, the two electrodes should be RA and LA of ECG Lead I, or RA and LL of ECG Lead II.

To prepare the Resp measurement, follow this procedure:

1. Connect the electrode cable to ECG connector.
2. Prepare the animal's skin.

Proper skin preparation is necessary for good signal quality at the electrode site, as the skin is a poor conductor of electricity.

 - a. If necessary, shave hair from skin at chosen sites.
 - b. Gently rub skin surface at sites to remove dead skin cells.
 - c. Thoroughly cleanse the site with a mild soap and water solution. We do not recommend using ether or pure alcohol, because this dries the skin and increases the resistance.
 - d. Dry the skin completely before applying the electrodes.
3. Select the Resp numeric area or waveform area to enter the **Resp** menu →set **Resp Lead**.
4. Apply the Electrodes.



5. Adjust parameters in the **Resp** menu to obtain the optimized waveform display.

CAUTION

- To reduce cardiovascular artifact, apply the respiration electrodes so that the liver area and the ventricles of the heart are not in the line between the respiratory electrodes.
- To optimize the respiration waveform, place the RA and LA electrodes horizontally when monitoring respiration with ECG Lead I; place the RA and LL electrodes diagonally when monitoring respiration with ECG Lead II.
- To optimize respiratory waveforms for animals breathing mainly abdominally, apply the LL electrode on the left abdomen at the point of maximum abdominal expansion.
- For animals expand chests laterally, to avoid negative intrathoracic pressure and optimize respiratory waveforms, respectively apply the electrodes in the right midaxillary and the left lateral chest areas at the maximum point of the breathing movement.
- Periodically inspect the electrode application site to ensure skin quality. If the skin quality changes, replace the electrodes or change the application site.

NOTE

- Store the electrodes at room temperature. Open the electrode package immediately prior to use.
 - Check that the electrode packages are intact and not expired. Make sure the electrode gel is moist.
-

9.5 Changing Resp Settings

9.5.1 Setting the Resp Alarm Properties

To set the Resp alarm properties, follow this procedure:

1. Select the Resp numeric area or waveform area to enter the **Resp** menu.
2. Select the **Alarm** tab.
3. Input the password if required.
4. Set alarm properties as desired.

NOTE

- **You can switch off the apnea alarm only when Apnea Alarm Off is enabled. For more information, see 7.6.10 Setting the Switch of the Apnea Alarm Off.**

9.5.2 Setting the RR Source

To set the RR source, follow this procedure:

1. Select the Resp numeric area or waveform area to enter the **Resp** menu.
2. Select the **Setup** tab.
3. Select **RR Source** from the drop-down list.

When you select **Auto**: the system automatically selects between CO₂ and ECG according to the priority. The priority of RR source is first CO₂, and then ECG.

CAUTION

- **When RR source is SpO₂, apnea alarms cannot be detected.**
- **The following factors may influence the accuracy of RR measurement sourcing from SpO₂: low perfusion; excessive motion on the measurement site; arrhythmia; RR signal too weak to be detected in the pleth waveform.**

9.5.3 Choosing the Respiration Lead

To set the respiration lead, follow this procedure:

1. Select the Resp numeric area or waveform area to enter the **Resp** menu.
2. Select the **Setup** tab.
3. Set **Resp Lead**.

If you cannot get optimal Resp waveform or you suspect the Resp value after choosing the Resp lead, you may need to optimize the electrode placement.

9.5.4 Setting the Resp Waveform Size

NOTE

- **After changing the respiration gain, check whether the threshold setting is reasonable. For details, see 9.5.7 Adjusting the Resp Waveform Detection Threshold.**

To set the Resp waveform size, follow this procedure:

1. Select the Resp numeric area or waveform area to enter the **Resp** menu.
2. Select the **Setup** tab.
3. Set **Gain**.

9.5.5 Setting the Resp Waveform Speed

To set the Resp waveform speed, follow this procedure:

1. Select the Resp numeric area or waveform area to enter the **Resp** menu.
2. Select the **Setup** tab.
3. Set **Speed**.

9.5.6 Setting the Auto Detection Switch

To set the auto detection switch, follow this procedure:

1. Select the Resp numeric area or waveform area to enter the **Resp** menu.
2. Select the **Setup** tab.
3. Switch on or off **Auto Threshold Detection**.
 - ◆ If **Auto Threshold Detection** is switched on, the monitor automatically adjusts the Resp waveform detection level, or threshold.
 - ◆ If **Auto Threshold Detection** is switched off, adjust the Resp waveform threshold. For more information, see *9.5.7 Adjusting the Resp Waveform Detection Threshold*.

In the auto detection mode, if ECG is switched off when you are monitoring respiration, the monitor cannot compare ECG and RR to detect cardiovascular artifact. To avoid cardiovascular artifact being interpreted as respiration, the respiration threshold is automatically set higher.

9.5.7 Adjusting the Resp Waveform Detection Threshold

It is recommended to use the manual detection mode in the following situations:

- The animal has intermittent mandatory ventilation.
- The animal's respiration is weak.
- The animal's RR is close to HR.

To set the Resp waveform threshold to the desired level, follow this procedure:

1. Select the Resp numeric area or waveform area to enter the **Resp** menu.
2. Select the **Threshold** tab.
3. Select the up and down arrows below **Upper Line** and **Lower Line** to define the Resp waveform threshold.

Once you set the Resp waveform threshold, it will not automatically adapt to different respiration depths. In the manual detection mode, cardiovascular artifact can be mistakenly interpreted as respiration in certain situations. This results in higher respiration rate or undetected apnea. If you suspect the RR reading, adjust the Resp waveform threshold to raise the detection level. If you cannot adjust threshold because the Resp waveform is too small, consider optimize the electrode placement.

CAUTION

- **Always remember that if the depth of breathing changes, you may need to change the detection level.**
 - **In the manual detection mode, if the respiration threshold is not correctly set, an apnea may not be detected. When the respiration threshold is set too low, the monitor may falsely interpreted cardiac activity as respiratory activity in the case of apnea.**
-

9.6 Resp Troubleshooting

For more information, see *D Alarm Messages*.

10 Monitoring Pulse Oxygen Saturation (SpO₂)

10.1 SpO₂ Introduction

Pulse Oxygen Saturation (SpO₂) monitoring is a non-invasive technique used to measure the amount of oxygenated haemoglobin and pulse rate by measuring the absorption of selected wavelengths of light. The light generated in the emitter side of the probe is partly absorbed when it passes through the monitored tissue. The amount of transmitted light is detected in the detector side of the probe. When the pulsative part of the light signal is examined, the amount of light absorbed by the haemoglobin is measured and the pulse oxygen saturation can be calculated. This device is calibrated to display functional oxygen saturation.

WARNING

- The SpO₂ extension cable should be compatible with the SpO₂ connectors. For example, you can only the Mindray SpO₂ extension cable to the Mindray SpO₂ connectors.
 - Measurement accuracy verification: The SpO₂ accuracy has been verified by comparing with arterial blood sample reference measured with a CO-oximeter. Pulse oximeter measurements are statistically distributed and about two-thirds of the measurements are expected to come within the specified accuracy range compared to CO-oximeter measurements.
 - A functional tester or SpO₂ simulator can be used to determine the pulse rate accuracy, but cannot be used to assess the SpO₂ accuracy.
-

10.2 SpO₂ Safety Information

WARNING

- If the animal has a trend of deoxygenation, analyze the blood samples with a laboratory CO-oximeter to completely understand the animal's condition.
 - Do not use the monitor or SpO₂ sensors during MRI scanning or in an MRI environment. Induced current could potentially causes burns. The monitor may affect the MRI image, and the MRI device may affect the accuracy of the SpO₂ measurements.
 - Prolonged continuous monitoring may increase the risk of undesirable changes in skin characteristics, such as irritation, reddening, blistering or burns. Inspect the sensor site every 30 minutes and move the sensor if the skin quality changes. For animals with poor peripheral blood circulation or sensitive skin, inspect the sensor site more frequently.
 - If the sensor is too tight because the application site is too large or becomes too large due to edema, excessive pressure for prolonged periods may result in venous congestion distal from the application site, leading to interstitial edema and tissue ischemia.
 - When animals are undergoing photodynamic therapy they may be sensitive to light sources. Pulse oximetry may be used only under careful clinical supervision for short time periods to minimize interference with photodynamic therapy.
 - Setting alarm limits to extreme values may cause the alarm system to become ineffective. For example, high oxygen levels may predispose a premature infant to retrolental fibroplasia. Setting the SpO₂ high alarm limit to 100% is equivalent to switching off the SpO₂ alarm.
 - To protect from electric shock, always remove the sensor and completely disconnect the pulse oximeter before bathing the animal.
 - The pulse oximeter function of the bedside monitor should not be used for apnea monitoring and arrhythmia analysis.
-

CAUTION

- **Change the application site or replace the sensor and/or animal cable when a persistent “SpO₂ Low Signal Quality” message is displayed on the equipment. These messages may indicate that animal monitoring time is exhausted on the animal cable or sensor.**
 - **Replace the cable or sensor when a “SpO₂ Sensor Off”, “SpO₂ No Sensor”, or “SpO₂ Low Signal Quality” message is consistently displayed while monitoring consecutive animals after completing troubleshooting steps listed in this manual.**
 - **Variation in measurements may be profound and may be affected by sampling technique as well as the animal's physiological conditions. Any results exhibiting inconsistency with the animal's clinical status should be repeated and/or supplemented with additional test data. Blood samples should be analyzed by laboratory instruments prior to clinical decision making to completely understand the animal's condition.**
 - **Use only SpO₂ sensors specified in this manual. Follow the instructions for use delivered with the SpO₂ sensor.**
 - **Do not place the pulse oximeter where the controls can be changed by the animal.**
 - **If using pulse oximetry during full body irradiation, keep the sensor out of the radiation field. If the sensor is exposed to the radiation, the reading might be inaccurate or the device might read zero for the duration of the active irradiation period.**
 - **Select proper SpO₂ sensor according to application site. Applying sensor too tight may severely obstruct circulation and lead inaccurate measurements. Loose application may result in measurement site exposing to ambient light.**
 - **Avoid placing the SpO₂ sensor on the same extremity with an NIBP cuff, arterial catheter, or intravascular line.**
 - **When monitoring SpO₂ at high ambient temperature, to avoid burns at the application site that is not well perfused, pay attention to prolonged SpO₂ sensor application.**
-

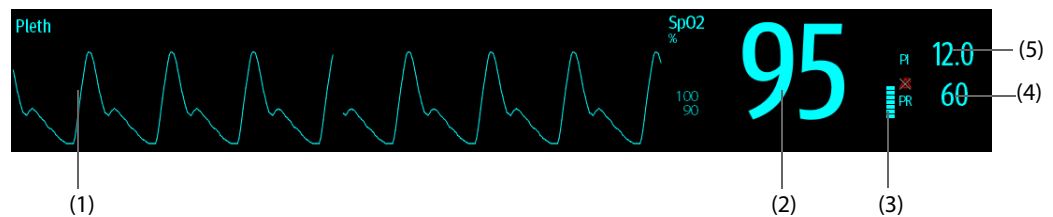
10.3 SpO₂ Measurement Limitations

The following factors may influence the accuracy of SpO₂ measurement:

- **Animal physiological characteristics:**
 - ◆ Cardiac arrest
 - ◆ Hypotension
 - ◆ Darkly pigmented skin
 - ◆ Shock
 - ◆ Severe vasoconstriction
 - ◆ Hypothermia
 - ◆ Severe anemia
 - ◆ Ventricular septal defects (VSDs)
 - ◆ Venous pulsations
 - ◆ Poor perfusion
 - ◆ Dysfunctional hemoglobin, such as carboxyhemoglobin (COHb) and methemoglobin (MetHb)
 - ◆ Elevated levels of bilirubin
 - ◆ Vasospastic disease, such as Raynaud's, and peripheral vascular disease
 - ◆ Hemoglobinopathies and synthesis disorders such as thalassemias, Hb s, Hb c, sickle cell, etc.
 - ◆ Hypocapnic or hypercapnic conditions
 - ◆ Birthmark(s), tattoos, skin discolorations, moisture on skin, deformed or abnormal fingers. etc.
- **Interfering substances:**
 - ◆ Intravascular dyes (such as indocyanine green, methylene blue, indigo carmine, etc.)
 - ◆ Dyes in the measure site.

- Environmental conditions:
 - ◆ Excessive ambient light
 - ◆ Electrosurgery equipment
 - ◆ Defibrillation (may cause inaccurate reading for a short amount of time)
 - ◆ Excessive animal/sensor motion
 - ◆ Electromagnetic field
 - ◆ Arterial catheters and intra-aortic balloon
- Others
 - ◆ Inappropriate positioning of the SpO₂ sensor, or use of incorrect SpO₂ sensor
 - ◆ Cuff or arterial blood pressure measurement device on the same limb as the SpO₂ sensor.

10.4 SpO₂ Display

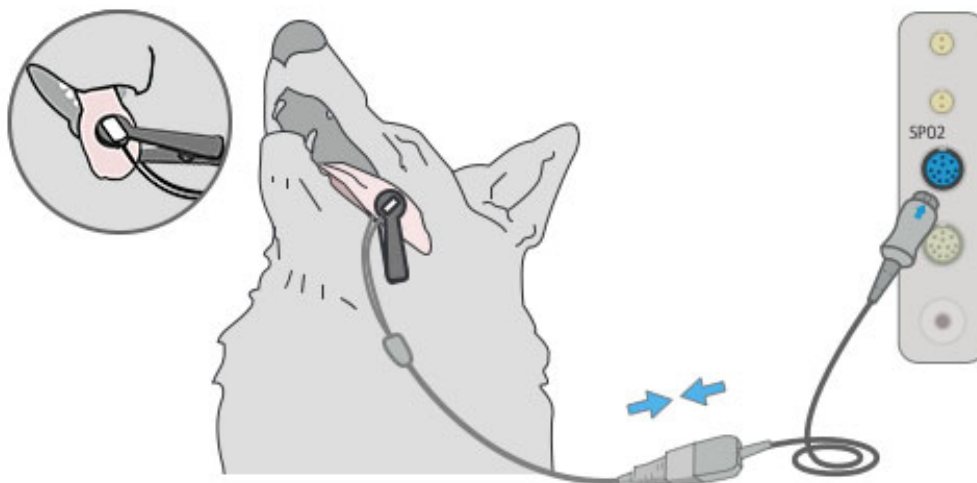


- (1) Pleth waveform (Pleth): indicates the blood pulsation at the measurement site. The waveform is not normalized.
- (2) Oxygen saturation of arterial blood (SpO₂): indicates the percentage of oxygenated hemoglobin relative to total hemoglobin.
- (3) Perfusion indicator: the pulsatile portion of the measured signal caused by arterial pulsation. The higher the bar, the better the perfusion quality.
- (4) Pulse rate: indicates the number of pulsations per minute.
- (5) Perfusion index (PI): indicates the percentage of pulsate signal to non pulsate signal. PI is an indicator of the pulsate strength. You can also use it to assess the SpO₂ signal strength.

For Mindray SpO₂ module,

- ◆ Above 1 is optimal.
- ◆ Between 0.3 and 1 is acceptable.
- ◆ Below 0.3 indicates low perfusion. Reposition the SpO₂ sensor or find a better site. If low perfusion persists, choose another method to measure oxygen saturation if possible.

10.5 Preparing for SpO₂ Monitoring



To prepare to monitor SpO₂, follow this procedure:

1. Select an appropriate SpO₂ clip according to the module type, application site, species and weight.
2. Connect the SpO₂ sensor to SpO₂ connector on the monitor.
3. Clean.
 - a. Clean the contact surface of the reusable sensor.
 - b. Clean the measurement site.
4. Apply the sensor to the animal.

The SpO₂ sensor selection and application site depend on the species. The preferred sensor site for canine and feline is on the tongue. The other sites such as lip, toe, prepuce, vulva or ear can also be measured.
5. Adjust parameters in the **SpO2** menu to obtain the optimized waveform display.

10.6 Changing the SpO₂ Settings

10.6.1 Changing the SpO₂ Alarm Settings

To change the SpO₂ alarm settings, follow this procedure:

1. Select the SpO₂ numeric area or waveform area to enter the **SpO2** menu.
2. Select the **Alarm** tab.
3. Input the password if required.
4. Set the alarm properties of SpO₂ and SpO₂ Desat.

NOTE

- You can switch off the SpO2 Desat alarm only when SPO2 Desat Alarm Off is enabled. For more information, see section 7.6.9 *Setting the Switch of the SpO2 Desat Alarm Off*.

10.6.2 Changing Sensitivity

The SpO₂ value displayed on the monitor screen is the average of data collected within a specific time. The shorter the averaging time is, the quicker the monitor responds to changes in the animal's oxygen saturation level. Contrarily, the longer the averaging time is, the slower the monitor responds to changes in the animal's oxygen saturation level, but the SpO₂ measurement is more stable. For critically ill animals, selecting shorter averaging time will help understanding the animal's state.

To set the averaging time, follow this procedure:

1. Select the SpO₂ numeric area or waveform area to enter the **SpO2** menu.
2. Select the **Setup** tab.
3. Set **Sensitivity**.

10.6.3 Showing/Hiding PI

You can set whether to display PI in the SpO₂ parameter area. To do so, follow this procedure:

1. Select the SpO₂ numeric area or waveform area to enter the **SpO2** menu.
2. Select the **Setup** tab.
3. Switch on or off **Display PI**.

10.6.4 Monitoring SpO₂ and NIBP Simultaneously

When monitoring SpO₂ and NIBP on the same limb simultaneously, you can switch on **NIBP Simul** to lock the SpO₂ alarm status until the NIBP measurement ends. If you switch off **NIBP Simul**, low perfusion caused by NIBP measurement may lead to inaccurate SpO₂ readings and therefore cause false physiological alarms.

To set the **NIBP Simul**, follow this procedure:

1. Select the SpO₂ numeric area or waveform area to enter the **SpO2** menu.
2. Select the **Alarm** tab.
3. Set **NIBP Simul**.

10.6.5 Changing the Sweep Speed of the Pleth Waveform

To set the sweep speed of Pleth waveform, follow this procedure:

1. Select the SpO₂ numeric area or waveform area to enter the **SpO2** menu.
2. Select the **Setup** tab.
3. Set **Speed**.

10.7 Changing the PR Settings

10.7.1 Changing the PR Alarm Settings

To change the PR alarm settings, follow this procedure:

1. Select the SpO₂ numeric area or waveform area to enter the **SpO2** menu.
2. Select the **PR Alarm** tab.
3. Input the password if required.
4. Set the alarm properties as desired.

10.7.2 Changing the QRS Volume

If the **Alarm Source** is set to **PR**, the QRS tone is derived from PR measurements. To set the QRS volume, follow this procedure:

1. Select the SpO₂ numeric area or waveform area to enter the **SpO2** menu.
2. Select the **PR** tab.
3. Select the **Setup** tab.
4. Set **QRS Volume**.

If the SpO₂ value is effective, the monitor also adjusts the QRS tone (pitch tone) according to the SpO₂ value. For information, see 20.11 *The Other Settings*.

10.7.3 Setting the PR Source

You can select the source of PR. The current PR source is displayed in the PR numeric area. PR from the current source is monitored as system pulse and generates alarms when you select PR as alarm source.

To set which pulse rate as PR source, follow this procedure:

1. Select the SpO₂ numeric area or waveform area to enter the **SpO2** menu.
2. Select the **PR** tab.
3. Select the **Setup** tab.
4. Set **PR Source**.

The **PR Source** menu displays the currently available PR sources from top to bottom by priority. When you select **Auto**, the system will automatically select the first option as the PR source. If the current PR source is unavailable, the system will automatically switch **PR Source** to **Auto**. When you select **IBP**, the system will automatically select the first pressure label as the PR source.

10.7.4 Showing/Hiding PR

You can set whether to display the PR value in the SpO₂ parameter area. To do so, follow this procedure:

1. Select the SpO₂ numeric area or waveform area to enter the **SpO2** menu.
2. Select the **PR** tab.
3. Select the **Setup** tab.
4. Switch on or off **Display PR**.

10.8 SpO₂ Troubleshooting

This section lists the problems that might occur. If you encounter the problems when using the equipment or accessories, check the table below before requesting for services. If the problem persists, contact the Customer Service Department or your local distributor.

NOTE

- For the physiological and technical alarm messages, see *D Alarm Messages*.

Problem	Solution
Do not see SpO ₂ numeric area or waveform area on the main screen.	1. Check that the SpO₂ is set to display in the Screen Setup menu. For more information, see 4.4.1 <i>Configuring the Normal Screen</i>. 2. Check that if the SpO₂ parameter switch is enabled. If not, enable the SpO₂ measurement. For more information, see 4.3 <i>General Settings</i>. 3. Check that the cable connections of SpO₂ sensor and the extension cable are tight. Replace the SpO₂ sensor or the extension cable if needed.
Dashes "--" display in place of numerics.	1. Check that the cable connections of SpO₂ sensor and the extension cable are tight. Replace the SpO₂ sensor or the extension cable if needed. 2. Reconnect the SpO₂ sensor if the alarm SpO2 Sensor Off appears. 3. Check the PI value. If the PI value is too low, adjust the SpO₂ sensor, or apply the sensor to the site with better perfusion. 4. Move the sensor to the place with weaker light, or cover the sensor with shade cloth if the alarm SpO2 Sensor Off appears.
Low amplitude SpO ₂ signal.	1. The SpO₂ sensor and NIBP cuff are placed on the same limb. Change a monitoring site if necessary. 2. Check the PI value. If the PI value is too low. Adjust the SpO₂ sensor, or apply the sensor to the site with better perfusion. 3. Check the sensor and its application site.

Problem	Solution
SpO2 value is inaccurate.	1. Check the animal's vital signs. 2. Check for conditions that may cause inaccurate SpO₂ readings. For more information, see <i>10.3 SpO2 Measurement Limitations</i>. 3. Check the monitor or the SpO₂ module for proper functioning.

11 Monitoring Temperature (Temp)

11.1 Temperature Introduction

You can continuously monitor the animal's skin temperature and core temperature. Thermally sensitive resistors (thermistors) are used. They are based on the principle that electrical resistance of the thermistor changes as temperature changes. Thermistors measure the resistance change and use it to calculate the temperature.

you can simultaneously monitor up to two temperature sites and calculate the difference between two measured sites.

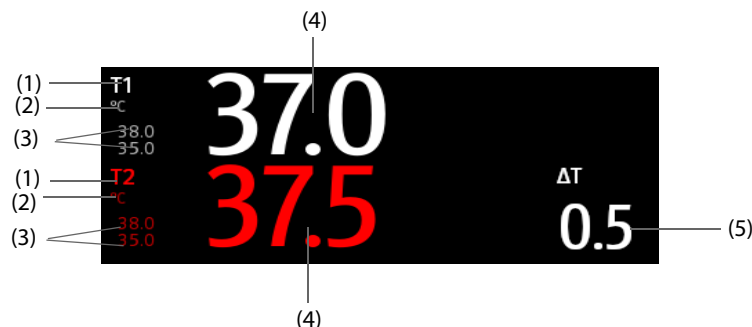
11.2 Displaying the Temp Numerics Area

To display the Temp numerics area, follow this procedure:

1. Access **Tile Layout** in either of the following ways:
 - ◆ Select the **Screen Setup** quick key → select the **Tile Layout** tab.
 - ◆ Select the **Main Menu** hard key or quick key → from the **Screen Setup** column select **Tile Layout**.
2. Select a parameter numeric area or waveform area, and then from the popup list select **Any Temp**.

11.3 Temperature Display

The following figure shows the Temp numeric area for temperature monitoring.



- (1) Temperature site (2) Temperature unit (3) Alarm limits (4) Temperature value
(5) Temperature difference (ΔT): Difference between two temperature sites. It displays only when ΔT is switched on.

11.4 Preparing for Temperature Monitoring

To prepare temperature monitoring, follow this procedure:

1. Select an appropriate probe for your animal according to species and measured site.
2. Plug the probe or temperature cable to the temperature connector. If you are using a disposable probe, connect the probe to the temperature cable.
3. Follow the probe manufacturer's instructions to connect the probe to the animal.

11.5 Changing Temperature Settings

11.5.1 Setting the Temperature Alarm Properties

To set the temperature alarm properties, follow this procedure:

1. Select the temperature numeric area to enter the **Temp** menu.

2. Select the **Alarm** tab.
3. Input the password if required.
4. Set the alarm properties.

11.5.2 Selecting the Temperature Label

Select the temperature label according to the measurement site. To do so, follow this procedure:

1. Select the temperature numeric area to enter the **Temp** menu.
2. Select the **Setup** tab.
3. Set the temperature label.

11.5.3 Displaying the Temperature Difference

To display the temperature difference between two measurement sites monitored by the same temperature module, switch on corresponding ΔT . To do so, follow this procedure:

1. Select the temperature numeric area to enter the **Temp** menu.
2. Select the **Setup** tab.
3. Switch on ΔT .

11.6 Temperature Troubleshooting

This section lists the problems that might occur. If you encounter the problems when using the equipment or accessories, check the table below before requesting for services. If the problem persists, contact the Customer Service Department or your local distributor.

NOTE

- For the physiological and technical alarm messages, see *D Alarm Messages*.

Problem	Solution
Do not see Temp numeric area on the main screen	1. Check that the Temp is set to display in the Screen Setup menu. For more information, see <i>4.4.1 Configuring the Normal Screen</i>. 2. Check that if the Temp parameter switch is enabled. If not, enable the Temp measurement. For more information, see <i>4.3 General Settings</i>. 3. Check that the connections of the temperature probe and the temperature cable are tight.
Measurement fails/'--' is displayed in the Temp numeric area	1. If you are using a disposable probe, check the connection between the probe and the temperature cable. 2. Try using a known good probe in case the sensor is damaged.

12 Monitoring Noninvasive Blood Pressure (NIBP)

12.1 NIBP Introduction

The monitor uses the oscillometric method for measuring the non-invasive blood pressure (NIBP). NIBP measurement is based on the principle that pulsatile blood flow through an artery creates oscillations of the arterial wall. The oscillometric device uses a blood pressure cuff to sense these oscillations that appear as tiny pulsations in cuff pressure. The oscillometric method measures the mean pressure and determines the systolic and diastolic pressures.

NOTE

- Blood pressure measurements determined with this device are equivalent to those obtained by a trained observer using the cuff/stethoscope auscultatory method or an intra-arterial blood pressure measurement device, within the limits prescribed by the American National Standard: manual, electronic, or automated sphygmomanometers.
 - NIBP measurement can be performed during electro-surgery and discharge of defibrillator.
-

12.2 NIBP Safety Information

WARNING

- Be sure to select the correct species setting for your animal before NIBP measurement.
 - Do not perform NIBP measurements on animals with sickle-cell disease.
 - To avoid further injury, do not apply the NIBP cuff on the limb with a wound.
 - Use clinical judgment to determine whether to perform frequent unattended blood pressure measurements on animals with severe blood clotting disorders because of the risk of hematoma in the limb fitted with the cuff.
 - To avoid the risk of animal injury, do not apply the NIBP cuff on a limb that has an intravenous infusion or catheter in place. Apply the cuff on another limb if possible.
 - Continuous cuff pressure due to connection tubing kinking may cause blood flow interference, and resulting in harmful injury to the animal.
 - NIBP reading can be affected by the measurement site, the position of the animal, exercise, or the animal's physiologic condition. If you doubt the NIBP measurements, determine the animal's vital signs by alternative means, and then verify that the monitor is working correctly.
 - Taking NIBP measurements exert pressure on the animal's tissue. This can cause skin purpura, ischemia, and neuropathy. Periodically check the cuff site and the limb distal to the cuff for normal color, warmth and sensitivity. If there is a sign of skin change or poor distal circulation, move the cuff to another limb or stop NIBP measurements. Check more frequently when using the STAT mode or using the auto mode at short intervals. Auto NIBP measurements with one and two minute intervals are not recommended for extended periods of time.
 - NIBP diagnostic significance must be decided by the physician.
-

CAUTION

- Using IABP may cause NIBP, including PR, measurements inaccurate or failed.
 - Only use parts and accessories specified in this manual. Follow the instructions for use and adhere to all warnings and cautions.
 - Accuracy of NIBP measurement depends on using a cuff of proper size. It is essential to measure limb circumference and choose a cuff with proper size.
-

12.3 NIBP Measurement Limitations

NIBP measurement may be inaccurate or impossible in the following situations:

- The animal is connected to a heart lung machine.
- Regular arterial pressure pulses are hard to detect
- The animal has cardiac arrhythmias.
- The animal's blood pressure changes dramatically.
- The animal has poor circulation due to severe shock or hypothermia.
- NIBP cuff is applied on an limb with edematous extremity.
- The NIBP cuff is compressed by excessive movement such as shivering, seizures, or convulsions.
- The animal's blood pressure is out of measurement range.

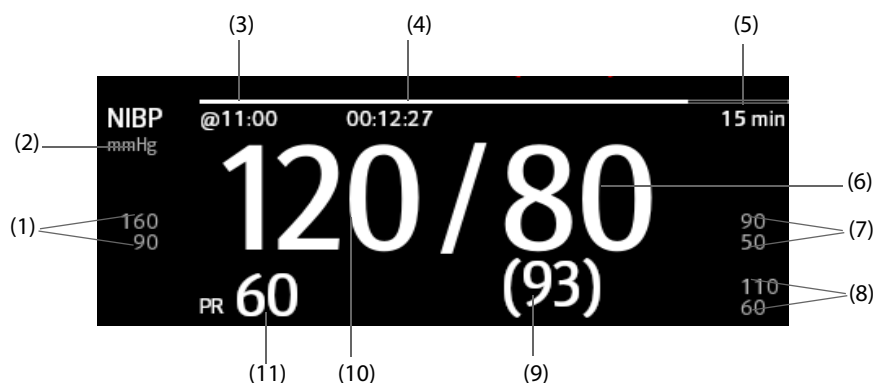
12.4 Measurement Modes

There are four NIBP measurement modes:

- Manual mode: measurement is taken on demand.
- Auto mode: repeated measurements are taken at set interval.
- STAT mode: continually rapid series of measurements are taken over a five-minute period.
- Sequence mode: continually automatic measurements are taken at set durations and intervals.
- Clock mode: automatic measurements are synchronized with the real time clock.

12.5 NIBP Display

The NIBP display shows no waveform and only shows the measurement result.



(1) Systolic pressure alarm limits

(2) NIBP unit: mmHg or kPa

(3) The last NIBP measurement time

(4) Time to the next measurement (for Auto mode and Sequence mode)

(5) Measurement mode: for Auto NIBP, interval is displayed; for Sequence mode, the current phase and interval are displayed

(6) Diastolic pressure

(7) Diastolic pressure alarm limits

(8) Mean pressure alarm limits

(9) Mean pressure (displayed after measurement completed) or cuff pressure (displayed during the measurement)

(10) Systolic pressure

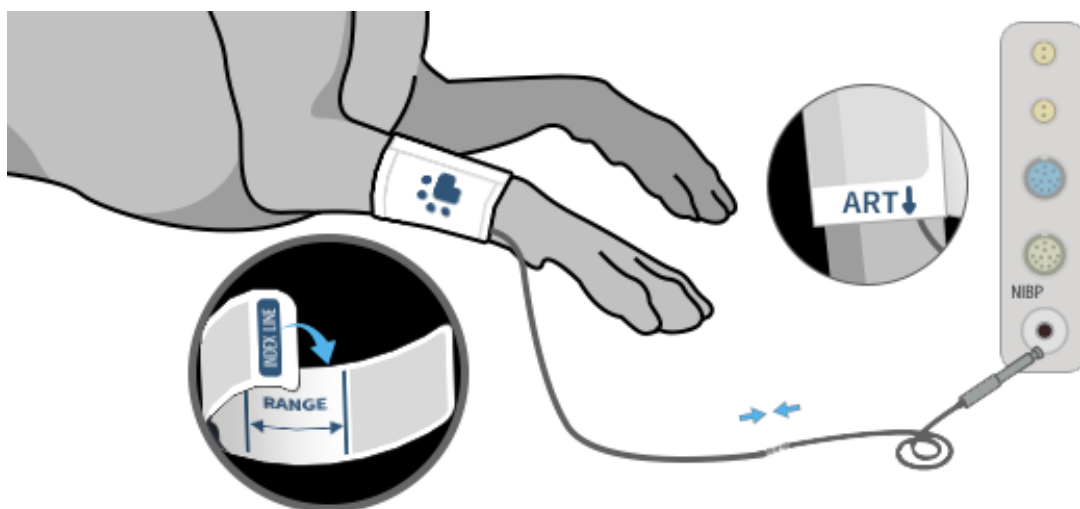
(11) Pulse Rate

NOTE

- If NIBP measurement fails, "XX" is displayed; if NIBP measurement is not taken, "--" is displayed.

- Outlined NIBP numerics indicate that the measurement is old and exceeds the set time. So these NIBP values are not recommended for reference.
-

12.6 Preparing for NIBP Measurements



To prepare to monitor NIBP, follow this procedure:

1. Verify that settings of species and weight value are set correctly on the monitor.
2. Connect the air tubing to the NIBP connector on the monitor.
3. Select an appropriate sized cuff for the animal.
Select a NIBP cuff by referring to the limb circumference marked on the NIBP cuff. The cuff width should be 40% of the circumference of the measurement site. Check that the NIBP cuff is completely deflated.
4. Connect the NIBP cuff to the air tubing.
Make sure that the air tubing is not compressed or twisted. Air must pass unrestricted through the tubing. For detailed information about the NIBP cuff, see the instructions delivered with it.
5. Apply the NIBP Cuff.
The cuff placement depends on the species and weight. When the animal is lying on the right side, left side or seated, place the NIBP cuff on the animal's limb; when the animal appears agitated or when placing the cuff to larger animals, place the NIBP cuff on the base of the tail.
6. Adjust parameters or select the measurement mode in the **NIBP** menu as necessary.
7. Start NIBP measurement. For detailed operations, see *12.7 Starting and Stopping NIBP Measurements*.
8. Stop NIBP measurement. For detailed operations, see *12.7 Starting and Stopping NIBP Measurements*.

NOTE

- Using a cuff of wrong size, or a cuff with twisted bladder and kinked air tubing, can cause inaccurate measurements.
 - Do not touch or apply external pressure against the cuff and air tubing during NIBP measurement. This may cause inaccurate blood pressure values.
 - Use care when placing the cuff on an extremity used for monitoring other animal parameters.
-

12.7 Starting and Stopping NIBP Measurements

Start and stop NIBP measurement by selecting the NIBP quick keys or from the NIBP menu.

Task	By Quick Key	From NIBP menu
Start a manual measurement	NIBP Start/Stop quick key 	Start NIBP button
Start auto NIBP series	NIBP Start/Stop quick key  Make sure to set Interval before starting auto NIBP.	Setup tab → set Interval → Start NIBP button
	NIBP Measure quick key  → select Interval	
Start NIBP sequence measurement	NIBP Measure quick key  → Sequence	Sequence tab → set NIBP sequence → Start NIBP button
Start STAT measurement	NIBP STAT quick key 	STAT button
	NIBP Measure quick key  → STAT	
Stop the current NIBP measurements	NIBP Start/Stop quick key 	Stop NIBP button
End auto NIBP series or NIBP Sequence	NIBP Stop All quick key 	NIBP Stop All button
Stop STAT measurement and end series	NIBP Start/Stop quick key 	Stop NIBP or NIBP Stop All button
	NIBP Stop All quick key 	

12.8 Viewing NIBP Analysis

NIBP analysis provides you a dynamic analysis of NIBP changes and distribution over the time scale. It allows you to know the animal's condition of the latest 24 hours before you entering the NIBP Analysis window.

To view NIBP analysis, follow this procedure:

1. Select the NIBP numeric area to enter the **NIBP** menu.
2. Select the **Setup** tab.
3. Select **Analysis**.

You can also select anywhere in the **NIBP Analysis** window to enter the tabular trends review page. For more information, see *16 Review*.

12.9 Changing NIBP Settings

12.9.1 Setting the NIBP Alarm Properties

To set the NIBP alarm properties, follow this procedure:

1. Select the NIBP numeric area to enter the **NIBP** menu.
2. Select the **Alarm** tab.
3. Input the password if required.
4. Set alarm properties as desired.

12.9.2 Setting the Initial Cuff Inflation Pressure

To set initial cuff inflation pressure, follow this procedure:

1. Select the NIBP numeric area to enter the **NIBP** menu.
2. Select **Initial Pressure**, and then select the appropriate setting.

NOTE

- For known hypertensive animals, you need to set initial cuff pressure to a higher value to reduce the measurement time.

12.9.3 Setting the NIBP Interval

For auto NIBP measurement, you need to set the interval between two NIBP measurements. To set the NIBP interval, follow this procedure:

1. Select the NIBP numeric area to enter the **NIBP** menu.
2. Set **Interval**. Selecting **Manual** switches to manual mode.

12.9.4 Selecting NIBP Start Mode

Start mode defines how NIBP auto mode works. To set the start mode, follow this procedure:

1. Select the NIBP numeric area to enter the **NIBP** menu.
2. Set **Start Mode**.
 - ◆ **Clock**: after the first measurement, the monitor automatically synchronizes NIBP automatic measurements with the real time clock. For example, if **Interval** is set to **20 min**, and you start NIBP auto measurement at 14: 03, the next measurement will be taken at 14: 20, and then at 14:40, 15:00, and so on.
 - ◆ **Interval**: after the first measurement, the monitor automatically repeats measurements at set interval. For example, if **Interval** is set to **20 min**, and you start NIBP auto measurement at 14:03, the next measurement will be taken at 14:23, and then at 14:43, 15:03, and so on.

12.9.5 Enabling the NIBP End Tone

The monitor can issue a reminder tone at the completion of NIBP measurement. The NIBP End Tone is off by default. To switch on the NIBP end tone, follow this procedure:

1. Select the NIBP numeric area to enter the **NIBP** menu.
2. Switch on **NIBP End Tone**.

12.9.6 Setting NIBP Sequence

NIBP sequence measurement can have up to five phases: A, B, C, D, and E. You can individually set the duration and interval of each phase.

To set NIBP sequence, follow this procedure:

1. Select the NIBP numeric area to enter the **NIBP** menu.
2. Select the **Sequence** tab.
3. Set **Duration** and Interval of each phase.

12.9.7 Setting the NIBP Display Format

To set the NIBP display format, follow this procedure:

1. Select the NIBP numeric area to enter the **NIBP** menu.
2. Set **Display Format**.

12.9.8 Setting the NIBP Alarm Limits Display Switch

To set whether to display the alarm limits of diastolic NIBP and mean NIBP, follow this procedure:

1. Select the NIBP numeric area to enter the **NIBP** menu.
2. Switch on or off **Display Alarm Limits**.

12.9.9 Showing/Hiding PR

You can set whether to display the PR value in the NIBP parameter area. To do so, follow this procedure:

1. Select the NIBP numeric area to enter the **NIBP** menu.
2. Switch on or off **Display PR**.

12.9.10 Correcting the NIBP Measurements

The middle of the cuff should be at the level of right atrium. If the limb is not at the heart level, you need to correct the measurement:

- Add 0.75 mmHg (0.10 kPa) to the displayed value for each centimeter higher.
- Deduct 0.75 mmHg (0.10 kPa) to the displayed value for each centimeter lower.

12.10 Assisting Venous Puncture

You can use the NIBP cuff to cause sub-diastolic pressure to block the venous blood vessel and therefore help venous puncture. To assist venous puncture, follow this procedure:

1. Select the **Venipuncture** quick key or select the NIBP numeric area.
2. Set **Venipuncture Pressure**.
3. Select **Venipuncture** at the bottom of the menu.
4. Puncture vein and draw blood sample.
5. Select the **NIBP Start/Stop** quick key to deflate the cuff.

During venous puncture, pay attention to the cuff pressure and the remaining time displayed in the NIBP numerics area.

12.11 NIBP Maintenance

12.11.1 NIBP Leakage Test

The NIBP leakage test checks the integrity of the system and of the valve. The NIBP leakage test should be performed once every 2 years or when you doubt the NIBP measurements. The NIBP leakage test should be performed by Mindray Animal Medical-qualified service personnel only.

12.11.2 NIBP Accuracy Test

The NIBP accuracy test should be performed once every two years or when you doubt the NIBP measurements. The NIBP accuracy test should be performed by Mindray Animal Medical-qualified service personnel only.

12.12 NIBP Troubleshooting

For more information, see *D Alarm Messages*.

13 Monitoring Invasive Blood Pressure (IBP)

13.1 IBP Introduction

You can monitor up to 2 invasive blood pressures.

13.2 IBP Safety Information

WARNING

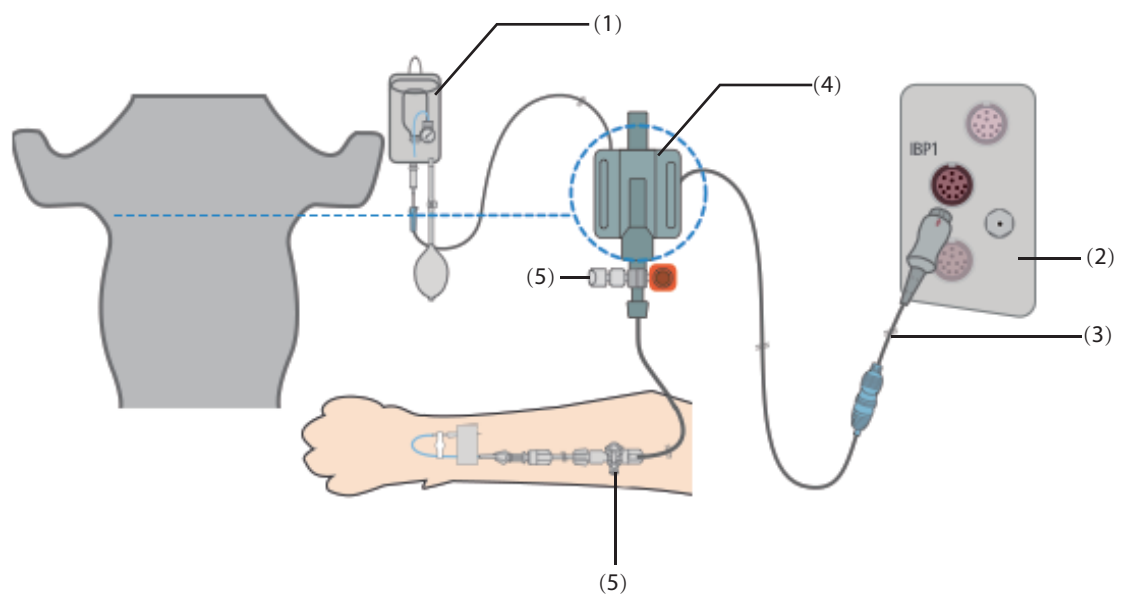
- Use only pressure transducers specified in this manual. Never reuse disposable pressure transducers.
- Make sure that the applied parts never contact other conductive parts.
- To reduce the hazard of burns during high-frequency surgical procedure, ensure that the monitor's cables and transducers never come into contact with the high-frequency surgical units.
- When using accessories, their operating temperature should be taken into consideration. For more information, see instructions for use of accessories.
- All invasive procedures involve risks to the animal. Use aseptic technique. Follow catheter manufacturer's instructions.
- Mechanical shock to the invasive blood pressure transducer may cause severe shifts in zero balance and calibration, and cause erroneous readings.

CAUTION

- Using IABP may cause IBP, including PR, measurements inaccurate or failed.

13.3 Preparing for IBP Monitoring

13.3.1 IBP Equipment Connection



(1) Pressure bag/Infusion pump

(2) IBP connector

(3) IBP cable

(4) IBP transducer

(5) Three-way valve

13.3.2 Measuring an Invasive Blood Pressure

To monitor IBP, follow this procedure:

1. Connect one end of the IBP cable to the IBP cable connector, and the other end to the IBP transducer.
2. Flush the IBP transducer system to exhaust all air from the tubing according to the manufacturer's instructions. Ensure that the system is free of air bubbles.
3. Connect the IBP transducer to the animal, making sure that the transducer is at the same horizontal level as the heart.
4. Select the proper pressure label for currently measured pressure. For more information, see *13.5.2 Changing the Pressure Label*.
5. Zero the IBP transducer. For more information, see *13.3.3 Zeroing the IBP transducer*. After a successful zeroing, turn off the stopcock to the air and turn on the stopcock to the animal.

CAUTION

- **Make sure that all the transducers are zeroed correctly before the IBP measure.**
 - **Make sure that no air bubble exists in the IBP transducer system before the IBP measure.**
-

13.3.3 Zeroing the IBP transducer

To avoid inaccurate pressure readings, the IBP transducer should be zeroed in accordance with the hospital policy. The IBP transducer should be zeroed in the following conditions:

- The IBP transducer or adapter cable is reconnected.
- The monitor restarts.
- You doubt the readings.
- The monitor displays the prompt message **Zero Required**.

To zero the transducer, follow this procedure:

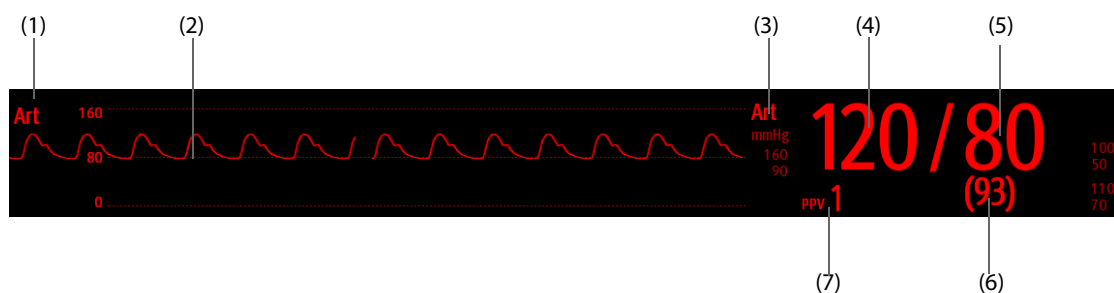
1. Connect the IBP transducer, the IBP adapter cable and the monitor.
2. Turn off the three-way valve (the one near the transducer) to the animal, in order to vent the transducer to the atmospheric pressure.
3. Zero the transducer by one of the following methods:
 - ◆ Select the numeric area (such as the Art numeric area), and then select **Zero** button.
 - ◆ Select the **Zero IBP** quick key.
4. After the zero calibration is completed, close the stopcock to the air and open the stopcock to the animal.

Zero calibration may fail in case of pressure fluctuation or pressure exceeding the calibration range. If zero calibration fails, follow this procedure:

1. Check that the three-way valve (the one near the transducer) is open to the air.
2. Perform zero calibration again. Do not sway the IBP transducer and tubing during zero calibration.

13.4 IBP Display

The IBP measurement is displayed on the monitor as a waveform and numeric pressures. For arterial pressure, the IBP numeric area displays systolic pressure, diastolic pressure and mean pressure. For venous pressure, the IBP numeric area displays only the mean pressure. The figure below shows the waveform and numerics for the Art pressure.



- | | |
|------------------------|-----------------------|
| (1) Pressure label | (2) Waveform |
| (3) Pressure Unit | (4) Systolic pressure |
| (5) Diastolic pressure | (6) Mean pressure |
| (7) PPV measurement | |

13.5 Changing IBP Settings

13.5.1 Changing the IBP Alarm Settings

To change the IBP alarm settings, follow this procedure:

1. Select the IBP numeric area or waveform area to enter the corresponding pressure menu.
2. Select the **Alarm** tab.
3. Input the password if required.
4. Set the alarm properties.

13.5.2 Changing the Pressure Label

A pressure label is used to define each type of pressure. Therefore, you should select a proper pressure label for the source of the pressure you want to monitor.

To select the pressure label, follow this procedure:

1. Select the IBP numeric area or waveform area to enter the corresponding pressure menu.
2. Select the **Setup** tab.
3. Set **IBP1 Label** or **IBP2 Label**.

Label	Description	Label	Description
PA	Pulmonary artery pressure	CVP	Central venous pressure
Ao	Aortic pressure	LAP	Left atrial pressure
UAP	Umbilical arterial pressure	RAP	Right atrial pressure
BAP	Brachial arterial pressure	P1 to P4	Non-specific pressure label
FAP	Femoral arterial pressure	UVP	Umbilical venous pressure
Art	Arterial blood pressure	LV	Left ventricular pressure

NOTE

- It is not allowed to select the same label for different pressures.

13.5.3 Setting the Pressure Type for Display

For the non-specific pressure (P1, P2, P3 or P4), the displayed pressure type is configurable. To set the displayed pressure type, follow this procedure:

1. Select the numeric area or waveform area of the non-specific pressure to enter the corresponding pressure menu.
2. Select the **Setup** tab.
3. Set **Measure**:
 - ◆ If this non-specific pressure is artery pressure, set the **Measure** to **All**. In this case, its corresponding numeric area displays systolic pressure, diastolic pressure and mean pressure.
 - ◆ If this non-specific pressure is venous pressure, set the **Measure** to **Mean Only**. In this case, its corresponding numeric area displays only the mean pressure.

13.5.4 Changing the Sensitivity

The IBP value displayed on the monitor screen is the average of data collected within a specific time. The shorter the averaging time is, the quicker the monitor responds to changes in the animal's blood pressure, and the higher the sensitivity. Contrarily, the longer the averaging time is, the slower the monitor responds to changes in the animal's blood pressure, the lower the sensitivity, but the measurement accuracy will be improved. For critically ill animals, selecting higher sensitivity will help understanding the animal's state.

To set the sensitivity, follow this procedure:

1. Select the IBP numeric area or waveform area to enter the corresponding pressure menu.
2. Select the **Setup** tab.
3. Set **Sensitivity**.

13.5.5 Setting the IBP Waveform

To set the IBP waveform, follow this procedure:

1. Select the IBP numeric area or waveform area to enter the corresponding pressure menu.
2. Select the **Setup** tab.
3. Set the following properties of the IBP waveform:
 - ◆ **Speed**
 - ◆ **Scale**: if **Auto** is selected, the size of the pressure's waveform will be adjusted automatically.

13.5.6 Setting the Display Format of Artery Pressure

To set the display format of the artery pressure, follow this procedure:

1. Select the numeric area or waveform area of any arterial pressure to enter the corresponding menu.
2. Select the **Setup** tab.
3. Set **Display Format**.

13.5.7 Showing/Hiding the Alarm Limits of Artery Pressure

To set whether to display the alarm limits of the arterial pressure, follow this procedure:

1. Select the numeric area or waveform area of any arterial pressure to enter the corresponding menu.
2. Select the **Setup** tab.
3. Switch on or off **Display Alarm Limits**.

13.5.8 Enabling PPV Measurement

PPV indicates pulse pressure variation. When measuring the arterial pressure (except PA), the PPV measurement is available. To enable the PPV measurement, follow this procedure:

1. Select the IBP numeric area or waveform area to enter the corresponding pressure menu.

2. Select the **PPV Setup** tab.
3. Switch on **PPV Measure**.

You can select PPV source after enabling the PPV measurement.

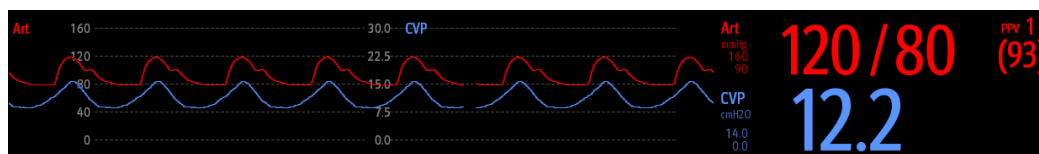
WARNING

- **PPV measurement is reliable only for mechanically ventilated animals with no arrhythmias.**
 - **PPV measurements may be inaccurate for animals with a very low respiration rates, low tidal volumes during ventilation, and with acute corpulmonale.**
 - **The clinical value of the PPV must be determined by the physician.**
-

13.5.9 Overlapping IBP Waveforms

The IBP waveforms can be displayed together. To combine IBP waveforms, follow this procedure:

1. Access **Tile Layout** by either of the following ways:
 - ◆ Select the **Screen Setup** quick key → select the **Tile Layout** tab.
 - ◆ Select the **Main Menu** hard key or quick key → from the **Screen Setup** column select **Tile Layout**.
2. Select the waveform area where you want to display the overlapped IBP waveforms, and then select the IBP waves to be overlapped on the left side of the same line.
3. Repeat step 2 in another waveform area if needed.
4. Select  to exit the window. The main screen will display the overlapped IBP waves.



Selecting the overlapped IBP waveforms on the main screen opens the **Overlapping Waveform Setup** menu, where you can make the following settings:

- **Scale**
 - ◆ Set **Left Scale** for the arterial pressure.
 - ◆ Set **Right Scale** for the venous pressure.
 - ◆ Set **CVP Scale** individually if the CVP waveform is combined and CVP unit is different from IBP unit.
 - ◆ Set **PA Scale** individually if the PA waveform is combined.
- Switch on or off **Gridlines** to show or hide gridlines in the overlapped waveform area.
- Set **Speed** for the overlapped waveforms.

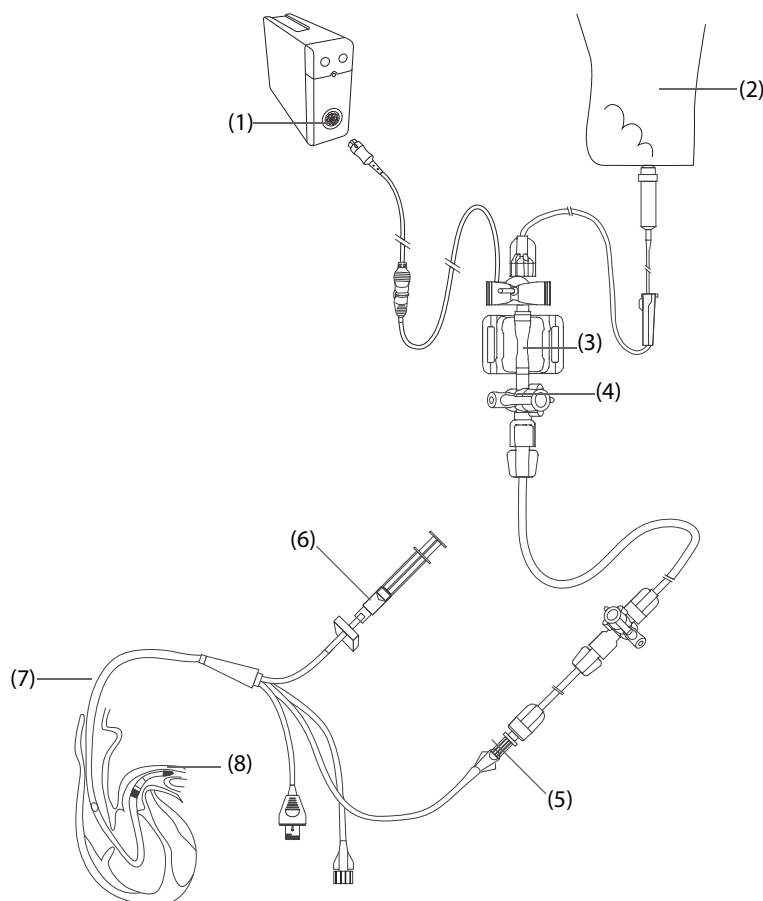
NOTE

- **The unit of CVP scale is consistent with CVP parameter unit.**
-

13.6 Measuring PAWP

PAWP reflects the pressure in the left ventricle at end-diastole. PAWP is derived from a pulmonary artery catheter when the pulmonary artery distal balloon is inflated and the catheter advances and occludes a distal pulmonary artery. PAWP values obtained at the end of the respiration cycle are the most accurate. At this time, the intrathoracic pressure is relatively constant and the respiration artifact is minimal.

13.6.1 PAWP Equipment Connection



(1) IBP connector

(2) Flush bag

(3) IBP transducer

(4) Three-way valve

(5) PA distal port

(6) Balloon inflation valve

(7) Thermodilution catheter

(8) Balloon

13.6.2 Preparing to Measure PAWP

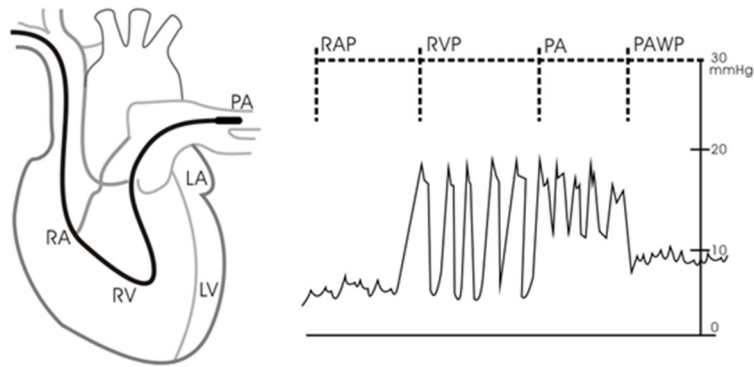
To prepare to monitor PAWP, follow this procedure:

1. Connect the IBP transducer, the IBP cable and the monitor. For more information, see *13.3.2 Measuring an Invasive Blood Pressure*.
2. Follow the manufacturer's instructions to connect the PA port of the thermodilution catheter and the animal end of the IBP transducer.
3. Zero the IBP transducer. For more information, see *13.3.3 Zeroing the IBP transducer*.
4. Set the IBP label to **PA** since the PAWP is measured on PA. For more information, see *13.5.2 Changing the Pressure Label*.

13.6.3 Measuring PAWP

To measure the PAWP, follow this procedure:

1. Select the PA numeric area or waveform area to enter the **PA** menu, and then select **PAWP**.
2. Wedge the flotation catheter into the pulmonary artery by observing the PA waveform changes on the screen, referring to the following figure.



3. Select **Start**.
4. Inflate the balloon and pay attention to PA waveform changes on the screen when the prompt message **Ready For Balloon Deflation** appears.
5. Deflate the balloon when the prompt message **Ready For Balloon Deflation** appears. If the PA waveform is stable yet the monitor still not show the prompt message **Ready For Balloon Deflation**, select the **Freeze** to freeze the waveform, and deflate the balloon.
6. Select **Accept** to save the PAWP value.
7. If you need to start a new measurement, repeat the step 3 to step 6.

If the measurement fails or you need to adjust the PAWP value, you can use the following buttons to adjust the PAWP waveform and measurement.

- Select the up or down arrow button to adjust the PAWP value.
- Select the left or right arrow button to view the frozen waveforms of 40 seconds.
- Select **Accept** to save the PAWP value.

WARNING

- Follow manufacturer's suggested procedures and hospital policy for PAWP balloon inflation. Inflating the balloon for an extra long time could result in pulmonary hemorrhage or infarction, or both.
 - A PAWP value greater than the systolic PA may indicate rupture of the pulmonary artery. Deflate the balloon immediately and report this event according to hospital policy.
-

NOTE

- The PA alarm is turned off automatically when the monitor enters the PAWP screen.
-

13.6.4 Setting the Waveforms of the PAWP Screen

On the **PAWP** screen, select **Setup** to enter the **PAWP Setup** menu. In the **PAWP Setup** menu, you can make the following settings:

- Select **Reference Waveform 1** to set an ECG lead wave as the first reference wave.
- Select **Reference Waveform 2** to set a respiration wave as the second reference wave.
- Select **Speed** to set a sweep speed for the displayed waveforms on the **PAWP** screen.
- Select **Scale** to set the size of the PA waveform on the **PAWP** screen.

13.6.5 Setting the Use PA-D as PAWP Switch

You can set whether PA-D value is used to replace PAWP value for hemodynamic calculation. To do so, follow this procedure:

1. Select the PA numeric area or waveform area to enter the **PA** menu.
2. Select the **Setup** tab.

3. Switch on or off **Use PA-D as PAWP**.

For more information on hemodynamic calculation, see *17.3.2 Hemodynamic Calculations*.

13.6.6 Performing Hemodynamic Calculation

On the **PAWP** screen, select **Hemo Calcs** to enter the **Hemo Calcs** menu. For more information, see *17.3.2 Hemodynamic Calculations*.

13.7 IBP Troubleshooting

This section lists the problems that might occur. If you encounter the problems when using the equipment or accessories, check the table below before requesting for services. If the problem persists, contact the Customer Service Department or your local distributor.

NOTE

- For the physiological and technical alarm messages, see *D Alarm Messages*.

Problem	Solution
Cannot see IBP numeric area or waveform area on the main screen	1. Check that the IBP is set to display in the Screen Setup menu. For more information, see <i>4.4.1 Configuring the Normal Screen</i>. 2. Check that if the IBP parameter switch is enabled. If not, enable the IBP measurement. For more information, see <i>4.4.4 Switching On or Off Parameters</i>. 3. Check the connection of IBP cable, IBP transducer and the monitor. 4. Check that the stopcock is turned to the correct position. 5. Check that the IBP transducer has been zeroed. For more information, see <i>13.3.3 Zeroing the IBP transducer</i>.
Cannot see systolic pressure and diastolic pressure for P1/P2/P3/P4	Set Measure to All in the P1/P2/P3/P4 setup menu. For more information, see <i>13.5.3 Setting the Pressure Type for Display</i> .
IBP readings seem unstable	1. Make sure there are no air bubbles in the transducer systems. 2. Check that the transducer is properly fixed. 3. Zero the transducer again. 4. Replace a transducer.
Zeroing of IBP channel(s) fails.	1. Ensure that the channels are open to air. 2. Perform zero calibration again. Do not sway the IBP transducer and tubing during zero calibration. For more information, see <i>13.3.3 Zeroing the IBP transducer</i>. 3. If zero calibration still fails, replace the transducer.

14 Monitoring Cardiac Output (C.O.)

14.1 C.O. Introduction

The monitor uses the thermodilution method to measure the animal's cardiac output (C.O.) and other hemodynamic parameters. Cold solution is injected into the right atrium and the temperature drop is measured at a downstream site. The C.O. value is calculated based on the curve of temperature change. Because the animal's cardiac output changes continuously, multiple measurements must be taken and averaged to get a reliable C.O. value.

14.2 C.O. Safety Information

WARNING

- **The C.O. measurement results may be erroneous during electrosurgery.**
 - **All invasive procedures involve risks to the animal. Use aseptic technique and follow catheter manufacturer's instructions.**
 - **Use only accessories specified in this manual. Make sure that the accessories never come into contact with conductive parts.**
-

14.3 C.O. Measurement Limitations

The following factors may influence the accuracy of C.O. measurement:

- Temperature of injectate solution
- Volume of injectate solution
- Baseline of animal's blood temperature
- Animal's inspiratory/expiratory cycle
- Placement of catheter with relation to proximity of lung field
- The catheter itself
- Animal's heart rate and hemodynamic status
- Any solution infused with intravenous injection during the C.O. measurement

To obtain accurate C.O. measurements, follow these recommendations:

- Temperature of injectate solution must be at least 10 °C cooler than that of the animal's blood.
- Inject solution at end of expiration.
- Inject solution rapidly and smoothly.
- Finish injection within four to five seconds.

14.4 C.O. Display

The C.O. display shows only C.O.(cardiac output), C.I. (cardiac index), and TB (blood temperature) in the C.O. numeric area.



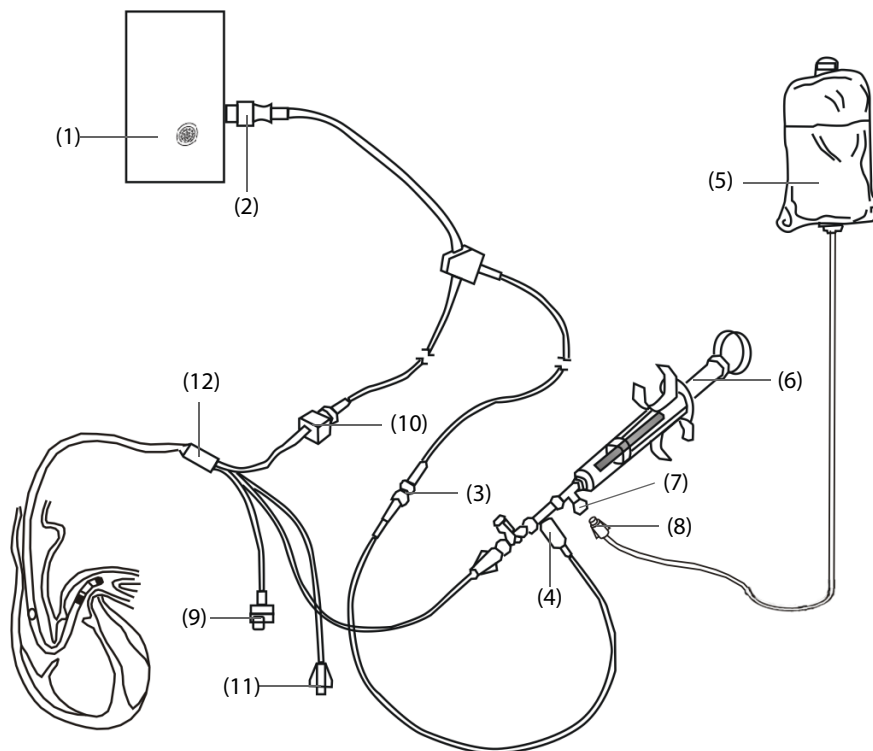
(1) C.O. label

(2) Primary parameter unit

(3) Labels and values for primary parameters

(4) Labels and values for secondary parameters

14.5 C.O. Equipment Connection



(1) C.O. module

(2) 12-pin C.O. cable (Model: CO7702)

(3) TI cable connector

(4) Temperature probe

(5) Injectate solution

(6) Injectate syringe

(7) Three-way valve

(8) Proximal injectate port

(9) Balloon inflation valve

(10) Thermistor connector

(11) PA distal port

(12) TB cable connector

14.6 Performing C.O. Measurement

14.6.1 Preparing for C.O. Measurement

Perform the following procedure:

1. Connect the C.O. cable to the C.O. connector and TB cable connector, making sure the C.O. numeric area is displayed on the monitor's main screen.
2. Follow the hospital's policy and procedures to prepare the animal for the C.O. measurement.
3. Follow the manufacturer's instructions to set up the catheter and other accessories.
4. Check that all the accessories are properly connected.

NOTE

- For an in-line probe setup, make sure the in-line sensor is securely connected to the tubing. For the bath probe setup, make sure the bath probe is correctly sensing the injectate temperature.

14.6.2 Setting C.O. Measurement

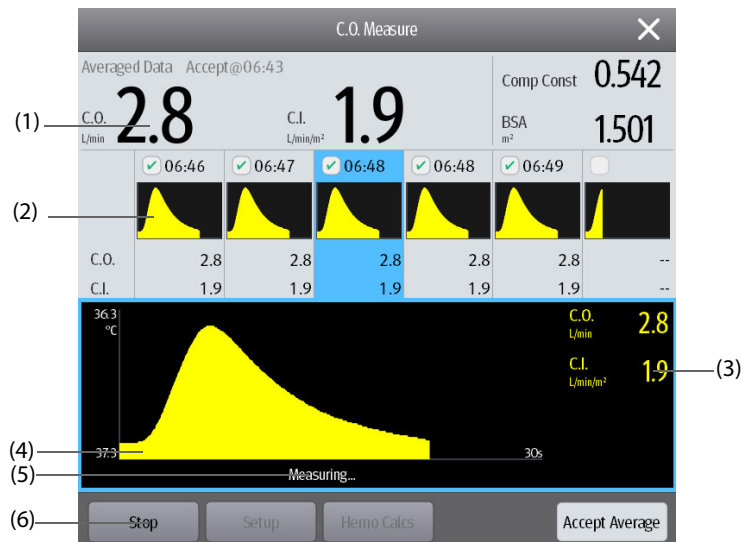
Before performing the C.O. measurement, follow this procedure:

1. Select the C.O. numeric area to enter the **C.O. Measure** menu.
2. Select the **Setup**.
3. Perform the following check or setup:
 - ◆ Check if the length and weight are appropriate for your animal. Change if necessary. The animal's length and weight values are required for determining cardiac index (C.I.).
 - ◆ Check that the correct computation constant is entered. The computation constant has a close relationship with the entered injectate volume, injectate probe type (in-line probe or bath probe) and temperature. See the Instruction for Use of pulmonary artery catheter to determinate. To change the computation constant, select **Comp Const** and then input the correct value. When a new catheter is used, the computation constant should be adjusted in accordance with the manufacturer's instructions for use.
 - ◆ Switch on or off **Auto TI**. If **Auto TI** is switched on, the system automatically detects the injectate temperature, and **TI** setting is disabled. If **Auto TI** is switched off, you need to input the injectate temperature at **TI**.
 - ◆ Switch on or off **Auto Start**. If **Auto Start** is switched on, the monitor automatically takes the C.O. measurement after establishing a baseline of blood temperature. If **Auto Start** is switched off, you need to click the **Start** button in the **C.O. Measure** window for a new measurement.

14.6.3 Performing C.O. Measurement

To perform the C.O. measurement, follow this procedure:

1. Select the C.O. numeric area to enter the **C.O. Measure** menu.



- (1) Average values
- (2) Historical measurement windows
- (3) Current measurement values
- (4) Current C.O. curve
- (5) Prompt message area
- (6) Buttons

2. Proceed as follows to perform the C.O. measure:

- ◆ If **Auto Start** is switched off, select the **Start** button, and then inject the solution quickly when you see the message **Please Wait**. As shown in the figure above, during the measurement, the currently

measured thermodilution curve is displayed. At the end of the measurement, the thermodilution curve is transferred to one of the 6 measurement windows and the monitor prompts you to wait for a certain period of time before starting a new measurement.

- ◆ If **Auto Start** is switched on, inject the solution quickly when you see the message **Ready For New Set Of Measurements**. The monitor consecutively takes C.O. measurements automatically without the need for pressing the **Start** button between two measurements. A new thermodilution measurement is possible as soon as the message **Inject Now!** is displayed on the screen. The monitor automatically detects further thermodilution measurements.
- 3. Acquire the average value of C.O. and C.I. A maximum of 6 measurements can be stored. Select from the 6 measurement curves and the system will automatically calculate and display the averaged C.O. and C.I. values. Then select the **Accept Average** button to accept and store the averaged values.

When injecting, the stopcock to the thermodilution catheter is open and the stopcock to the injectate solution is closed. After completing the measurement, turn off the stopcock to the thermodilution catheter and turn on the stopcock to the injectate solution, and then draw the injectate solution into the injectate syringe.

The button area also provides you with the following functions:

- Select **Stop** to stop the current measurement.
- Select **Setup** to enter the **C.O.** menu.
- Select **Hemo Calcs** to enter the **Calculations** menu. For details, see *17 Auxiliary Function*

NOTE

- **Starting a measurement without blood temperature being stable may cause measurement failure.**
- **The TB alarms are inactivated during a C.O. measurement, and will be reactivated automatically after the completion of C.O. measurement.**
- **Please see the Instructions for Use of thermodilution catheter to determine the Comp Const and the volume of injectate solution.**

14.7 Changing C.O. Settings

14.7.1 Setting C.O. Alarm Properties

To set the C.O. alarm properties, follow this procedure:

1. Select the C.O. numeric area to enter the **C.O. Measure** menu.
2. Select **Setup** to enter the **C.O.** menu.
3. Select the **Alarm** tab.
4. Input the password if required.
5. Set alarm properties as desired.

14.7.2 Selecting the Primary C.O. Parameter

You can select C.O. or C.I. as the main C.O. parameter. The measurement of the primary parameter displays in larger numerics. To do so, follow this procedure:

1. Select the C.O. parameter area to enter the **C.O. Measure** menu.
2. Select the **Setup** tab.
3. Set **Primary Parameter**.

14.8 C.O. Troubleshooting

This section lists the problems that might occur. If you encounter the problems when using the equipment or accessories, check the table below before requesting for services. If the problem persists, contact the Customer Service Department or your local distributor.

NOTE

- For the physiological and technical alarm messages, see *D Alarm Messages*.

Problem	Solution
Do not see C.O. numeric area on the main screen	1. Check that the C.O. is set to display in the Screen Setup menu. For more information, see <i>4.4.1 Configuring the Normal Screen</i>. 2. Check that if the C.O. parameter switch is enabled. If not, enable the C.O. measurement. For more information, see <i>4.3 General Settings</i>. 3. Check the connection of C.O. cable, thermodilution catheter and TI sensor.
C.O. value is inaccurate	1. Check that the thermodilution catheter is positioned properly. 2. Check that the computational constant is proper for current injectate temperature, injectate volume and injectate probe type. 3. Inject solution rapidly and smoothly. 4. Finish injection within four to five seconds. 5. Inject more volume, or inject colder solution. 6. Check that the length and weight of animal is properly configured. 7. If Auto TI is switched off, check that the entered temperature is correct.
C.O. measurement fails	1. Inject more volume, or inject colder solution. Make sure that the injectate temperature is at least 10°C colder than the animal blood temperature. 2. Finish injection within four to five seconds. 3. Check the connection of C.O. cable, thermodilution catheter and TI sensor.

15 Monitoring Carbon Dioxide (CO₂)

15.1 CO₂ Introduction

CO₂ monitoring is a continuous, non-invasive technique for determining the concentration of CO₂ in the animal's airway by measuring the absorption of infrared (IR) light of specific wavelengths. CO₂ has its own absorption characteristic and the amount of light passing the gas probe depends on the concentration of the measured CO₂. When a specific band of IR light passes through respiratory gas samples, some of IR light will be absorbed by the CO₂ molecules. The amount of IR light transmitted after it has been passed through the respiratory gas sample is measured with a photodetector. From the amount of IR light measured, the concentration of CO₂ is calculated.

The following two methods are used for CO₂ monitoring:

- Mainstream CO₂ method: the CO₂ sensor is inserted on the airway adapter which is directly connected to the animal's airway. The mainstream CO₂ measurement can be used, with specified accessories, with intubated animals.
- Sidestream CO₂ method: a sample line is used to take the respiratory gas from the animal's airway. The CO₂ sensor is built into the CO₂ module. The sidestream module can be used with intubated and non-intubated animals. With intubated animals, the respiratory gas is sampled from the animal's breathing circuit through an airway adapter and a airway sampling line. With non-intubated animals, the gas is sampled through a nasal simple line.

15.2 CO₂ Safety Information

WARNING

- **Route all tubing away from the animal's throat to avoid strangulation.**
-

CAUTION

- **Remove the airway sample line from the animal's airway while nebulized medications are being delivered.**
 - **EtCO₂ values measured from the CO₂ module may differ from those of from the blood gas analysis.**
-

NOTE

- **The CO₂ module automatic suppresses physiological alarms until breathing waves have been detected. Make sure that an animal is properly connected when monitoring with the CO₂ module.**
-

15.3 CO₂ Measurement Limitations

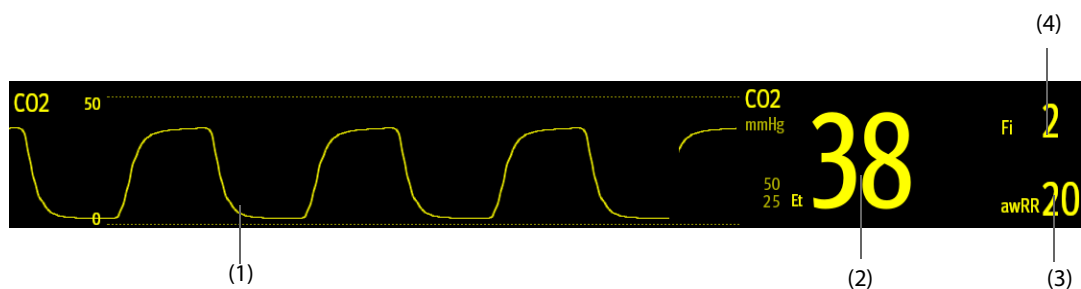
The following factors may influence the measurement accuracy:

- Leaks or internal venting of sampled gas
- Mechanical shock
- Cyclic pressure up to 10 kPa (100 cmH₂O)
- Other sources of interference, if any

Measurement accuracy of the sidestream CO₂ module may be affected by the breath rate and inspiration/expiration (I/E) ratio.

15.4 CO₂ Display

The CO₂ numeric and waveform area provide FiCO₂ measurement, EtCO₂ measurement, awRR measurement, and a CO₂ waveform.



(1) CO₂ waveform

(2) End tidal CO₂ value (EtCO₂)

(3) Airway respiration rate (awRR)

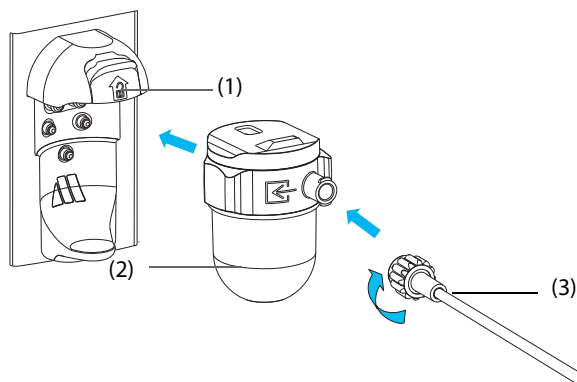
(4) Fraction of inspired CO₂ (FiCO₂)

15.5 Measuring CO₂ Using Sidestream CO₂ Module

15.5.1 Preparing to Measure CO₂ Using Sidestream CO₂ Module

To prepare the CO₂ module for measurement, follow this procedure:

1. Select the appropriate gas sample line and water trap according to the species.
2. Connect the DRYLINE II water trap to the CO₂ module, and connect the gas sample line to the water trap.



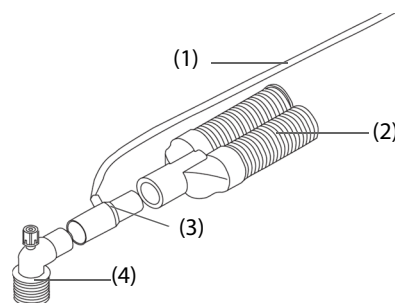
(1) Water trap receptacle

(2) DRYLINE II water trap

(3) Gas sample line

3. Connect the other end of the gas sample line to the animal.

For intubated animals requiring an airway adapter, install the airway adapter between the animal circuit and the Y-piece of the breathing tube.



- | | |
|--------------------|-------------------------------|
| (1) Sample line | (2) Connect to the ventilator |
| (3) Airway adapter | (4) Connect to the animal |

4. Connect the gas outlet to the scavenging system using an exhaust tube.

After the water trap is connected, it enters measure mode by default and the monitor displays **CO₂ Starting**. CO₂ can be measured after the start-up is complete.

WARNING

- **Connect the gas outlet to the scavenging system when measuring CO₂ using the sidestream CO₂ module.**
-

CAUTION

- **Leakage in the breathing or sampling system may cause the EtCO₂ readings to be significantly low. Always make sure that all the connections are tight and there is no leak in the system.**
 - **Inspect the airway adapter for a tight connection and proper operation before attaching it to the animal.**
 - **Squeezing or bending the sample line during the sidestream CO₂ measurement may cause inaccurate CO₂ reading or no reading.**
 - **To avoid blocking the airway, empty the DRYLINE II water trap container whenever half full. Dispose of accumulated fluids in accordance with hospital policy or your local regulations.**
 - **The DRYLINE II water trap has a filter preventing bacterium, water and secretions from entering the module. Extended use could destroy the filter in water trap and fail to stop the bacterium, water and secretions entering the module, result in damaging the gas module and having infection risk. Replacing the DRYLINE II water trap once a month is recommended.**
-

NOTE

- **To extend the lifetime of the water trap and module, disconnect the water trap from the module and set the operating mode to Standby mode when CO₂ monitoring is not required.**
 - **The sample rates are different when different types of water traps are used.**
-

15.5.2 Zeroing the Sidestream CO₂ Module

The sidestream modules perform a zero calibration automatically when needed. Once the zero calibration is started, the CO₂ module stops measuring and **"Zeroing"** is displayed in the CO₂ numeric area.

After the zero calibration is completed, the CO₂ module reacquires the CO₂ readings. During the reacquisition period, **"Zero Recovering"** is displayed in the CO₂ numeric area. Valid data will reappear 30 seconds after the zero calibration is started. You can hide the display of the **"Zero Recovering"** message, but values displayed during the reacquisition period may not be accurate.

The automatic zero calibration will not start under the following conditions:

- Physiological alarms related to CO₂ are active.
- An apnea alarm is active.
- No breath has been detected for over 30 seconds.

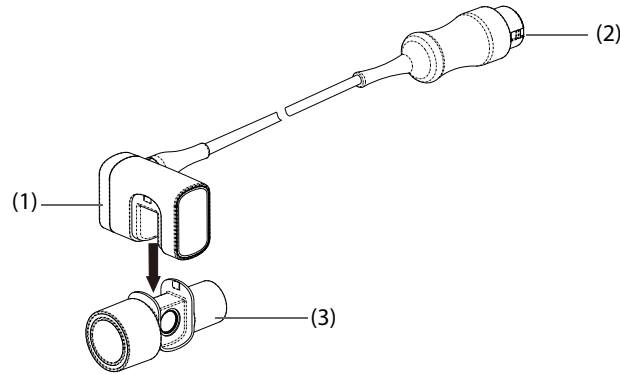
You can also perform the zero calibration manually. For more information, see *20.6.2 The CO₂ Tab*.

15.6 Measuring CO₂ Using Mainstream CO₂ Module

15.6.1 Preparing to Measure CO₂ Using Mainstream CO₂ Module

To prepare the CO₂ module for measurement, follow this procedure:

1. Connect the airway adapter to the sensor head.

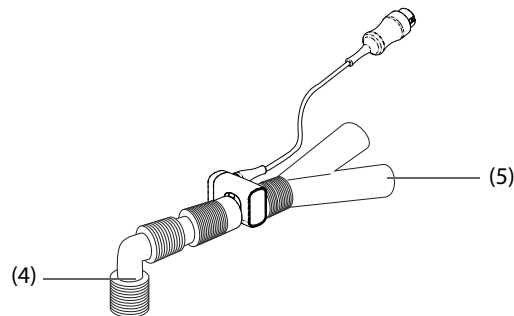


(1) Sensor

(2) Connect to module

(3) Airway adapter

2. Attach the sensor connector to the CO₂ connector on the mainstream CO₂ module.
3. Zero the sensor after the warm-up is finished. For more information, see *15.6.2 Zeroing the Mainstream CO₂ Sensor*.
4. After the zero calibration is finished, connect the airway as shown below.



(4) Connect to animal

(5) Connect to ventilator

5. Make sure that no leakages are in the airway and then start a measurement.

NOTE

- **Be sure to set the barometric pressure properly before using the mainstream CO₂ module. Improper settings will result in erroneous CO₂ reading.**
- **Always position the sensor with the adapter in an upright position to avoid collection of fluids in the windows of the adapter. Large concentrations of fluids at this point will obstruct gas analysis.**
- **To avoid dead space, place the sensor as close to the animal as possible.**

15.6.2 Zeroing the Mainstream CO₂ Sensor

For mainstream CO₂ modules, the sensor should be zeroed in the following conditions:

- Before each measurement.
- A new adapter is used.
- Reconnect the sensor to the module.

- The message **CO2 Zero Required** displays. In this case, check the airway adapter for any blockage, e.g. mucus, etc. If a blockage is detected, clear or replace the adapter.

To zero the sensor, follow this procedure:

1. Connect the sensor to the module.
2. In the **CO2** menu, select **Setup** tab.
3. Set the **Operating Mode** to **Measure**. The message **CO2 Sensor Warmup** is displayed.
4. After warm-up is finished, connect the sensor to a clean, dry airway adapter. The adapter should be vented to the air and isolated from CO₂ sources, such as ventilator, the animal's breathing, your own breathing, etc.
5. Select **Zero** in the **CO2** menu. The message **Zeroing** is displayed.

It takes about 15 to 20 seconds. The message disappears when the zero calibration is completed.

WARNING

- When perform a zero calibration during the measurement, disconnect the sensor from the animal's airway first.
 - Do not rely on the readings during CO₂ zeroing.
-

15.7 Changing Settings for All CO₂ Modules

15.7.1 Changing CO₂ Alarm Settings

To change the CO₂ alarm settings, follow this procedure:

1. Select the CO₂ numeric area or waveform area to enter the **CO2** menu.
2. Select the **Alarm** tab.
3. Input the password if required.
4. Set alarm properties as desired.

15.7.2 Setting the CO₂ Waveform

To set the CO₂ waveform, follow this procedure:

1. Select the CO₂ numeric area or waveform area to enter the **CO2** menu.
2. Select the **Setup** tab.
3. Set **Waveform Type**, **Speed**, **Scale**, or **CO2 Scale** of the CO₂ waveform.

15.7.3 Setting the RR Source

To set the respiration rate (RR) source, follow this procedure:

1. Select the CO₂ numeric area or waveform area to enter the **CO2** menu.
2. Select the **Setup** tab.
3. Set **RR Source**.

When the current RR source does not have valid measurement, the system will automatically switch **RR Source** to **Auto**.

15.7.4 Entering the Standby Mode

You can set the CO₂ module to one of the following modes according to the module status:

- Select **Measure** mode when you use the CO₂ module for monitoring.
- Select **Standby** mode when you do not use the CO₂ module to prolong the service life of the CO₂ module.

The default operating mode is **Measure**. If you are not using the CO₂ module, you can proceed as follows to enter the Standby mode:

1. Select the CO₂ numeric area or waveform area to enter the **CO2** menu.
2. Select the **Setup** tab.
3. Set **Operating Mode** to **Standby**.

15.7.5 Entering the Intubation Mode

When performing intubation during general anesthesia, in order to reduce unnecessary alarms, you can enter the intubation mode. To enter the intubation mode, follow this procedure:

1. Select the CO₂ numeric area or waveform area to enter the **CO2** menu.
2. Select **Intubation Mode**.

For the details of the intubation mode, see 7.12 *Intubation Mode*.

15.8 Changing Settings for Sidestream CO₂ Module

15.8.1 Setting the Auto Standby

The monitor enters standby mode automatically after the configured period of time if no breath is detected since the last detected breath. To set the auto standby, follow this procedure:

1. Select the CO₂ numeric area or waveform area to enter the **CO2** menu.
2. Select the **Setup** tab.
3. Set **Auto Standby**.

15.8.2 Setting Humidity Compensation

The presence of humidity in breathing circuit may raise the CO₂ reading. For the sidestream CO₂ module, you can switch humidity compensation on or off to correct the CO₂ reading according to the actual condition.

- Body Temperature and Pressure Saturated Gas (BTPS), or wet gas
- Ambient Temperature and Pressure Dray (ATPD), or dry gas

The CO₂ partial pressure is calculated as follows:

- ATPD: $P_{CO_2}(mmHg) = CO_2(vol\%) \times P_{amb} / 100$
- BTPS (sidestream): $P_{CO_2}(mmHg) = CO_2(vol\%) \times (P_{amb} - 47) / 100$

Where, $P_{CO_2}(mmHg)$ = partial pressure, $vol\%$ = CO₂ concentration, P_{amb} = ambient pressure, and unit is mmHg.

To set the humidity compensation, follow this procedure:

1. Select the CO₂ numeric area or waveform area to enter the **CO2** menu.
2. Select the **Setup** tab.
3. Set **BTPS Compensation**.
 - ◆ Switch on for BTPS.
 - ◆ Switch off for ATPD.

15.9 Setting the Gas Compensation

The presence of interfering gas affects the CO₂ measurement. To get the best possible measuring result, it is needed to set the gas compensation. The configured concentration of the interfering gas should be in accordance with its actual proportion.

WARNING

- **Make sure to use the appropriate compensations. Inappropriate compensations may cause inaccurate measurement values and result in misdiagnosis.**
-

For the sidestream CO₂ module, follow this procedure to set the gas compensation:

1. Select the CO₂ numeric area or waveform area to enter the **CO2** menu.
2. Select the **Setup** tab.
3. Set the compensation according to the actual condition.

For the mainstream CO₂ module, follow this procedure to set the gas compensation:

1. Select the CO₂ numeric area or waveform area to enter the **CO2** menu.
2. Select the **Setup** tab.
3. Set the following compensation according to the actual condition.

■ **Balance Gas**

- ◆ Select **Room Air** when air predominates in the ventilation gas mixture.
- ◆ Select **N2O** when N₂O predominates in the ventilation gas mixture.
- ◆ Select **He** when He predominates in the ventilation gas mixture.

■ **O2 Compensation**

- ◆ Select **Off** when the amount of O₂ is less than 30%.
- ◆ Select an appropriate setting according to the amount of O₂ in the ventilation gas mixture.

- **AG Compensation:** enters the concentration of anesthetic gas present in the ventilation gas mixture. This could compensate for the effect of AG on the readings.

15.10 Choosing a Time Interval for Peak-Picking

For mainstream CO₂ modules, you can select a time interval for picking the highest CO₂ as the EtCO₂ and the lowest as the FiCO₂.

To set the time interval, follow this procedure:

1. Select the CO₂ numeric area or waveform area to enter the **CO2** menu.
2. Select the **Setup** tab.
3. Set **Maximum Hold**.
4. Toggle between **Single Breath, 10 s** and **20 s** if mainstream CO₂ module is configured.
 - ◆ **Single Breath:** EtCO₂ and FiCO₂ are calculated for every breath.
 - ◆ **10 s, 20 s, or 30 s:** EtCO₂ and FiCO₂ are calculated using 10, 20 or 30 seconds of data.

15.11 Changing Barometric Pressure

Both sidestream CO₂ module has the function of automatic barometric pressure compensation (the system automatically measures the barometric pressure to which the animal monitor is exposed). However, the mainstream CO₂ module does not have such function. For the mainstream CO₂ module, the default barometric pressure is 760 mmHg. You must modify the barometric pressure based on the actual situation.

This function is password protected. For more information, see *20.11 The Other Settings*.

WARNING

- **Be sure to set the barometric pressure properly before using the mainstream CO₂ module. Improper settings will result in erroneous CO₂ reading.**
-

15.12 Performing the Leakage Test

When measuring CO₂ using the sidestream CO₂ module, leakage test is required every time before the CO₂ measurement. To perform the CO₂ leakage test, follow this procedure:

1. Connect the measuring accessories as per section 15.5.1 *Preparing to Measure CO₂ Using Sidestream CO₂ Module*.
2. Wait until the startup finishes. Completely block the gas inlet on the sidestream CO₂ module or on the N1. Then the alarm message "**CO₂ Airway Occluded**" will appear on the screen.
3. Block the gas inlet for another one minute.
4. Select the **Main Menu** hard key or quick key → from the **System** column select **Maintenance** → input the required password → select Enter key.
5. Select the **Module** tab → **CO₂** tab.
6. Check that the current flow rate is less than 10ml/min, and the alarm message "**CO₂ Airway Occluded**" does not disappear. This indicates that the module does not leak. If the alarm message disappears, or the flow rate is equal to 10ml/min or greater, it indicates that the module leaks. Perform the leakage test again. If the problem remains, contact the Customer Service Department or your local distributor for help.

15.13 CO₂ Calibration

For sidestream CO₂ modules, a calibration is needed every year or when the measured values have a great deviation. For maintream CO₂ module, no calibration is needed.

To calibrate the CO₂ module, contact the Customer Service Department or your local distributor.

CAUTION

- **Connect the gas outlet to the scavenging system when calibrating the CO₂ module.**
-

15.14 CO₂ Troubleshooting

This section lists the problems that might occur. If you encounter the problems when using the equipment or accessories, check the table below before requesting for services. If the problem persists, contact the Customer Service Department or your local distributor.

NOTE

- **For the physiological and technical alarm messages, see *D Alarm Messages*.**
-

15.14.1 Troubleshooting the Sidestream CO₂ Module

Problem	Solution
EtCO ₂ measurements too low	1. Ventilate the room if the environmental CO₂ concentration is too high. 2. Check the sample line and connectors for leakage. 3. Check the animal status.

15.14.2 Troubleshooting the Mainstream CO₂ Module

Problem	Solution
Elevated baseline	1. Check the animal status. 2. Check the sensor.

16 Review

16.1 Review Overview

The monitor provides the trend data and event records to help you evaluate how the animal's condition is developing.

16.2 Review Page

The **Review** page contains tabs to display trend data in tabular, graphic, or other forms.

16.2.1 Accessing the Review Page

To enter the review page, choose any of the following ways:

- Select the **Review** quick key → select the desired tab. If reviewing animal data is password protected, input the monitor's clinical password (local password).
- Select the **Main Menu** hard key or quick key → from the **Review** column select the desired option. If reviewing animal data is password protected, input the monitor's clinical password (local password).

16.2.2 Example Review Page

The review pages have similar structure. The **Graphic Trends** review page is taken as an example.



- (1) Event type indicator: different color blocks match different types of events:
 - Red: high priority alarm event
 - Yellow: medium priority or low priority alarm event
 - Green: manual event
 - White: operation-related event
- (2) Current window time line: indicates the time length of the current window.
- (3) Waveform area: displays trend curves. The color of trend curves is consistent with the color of parameter labels.
- (4) Time line: indicates the entire time length.
 - [Dark Gray Block]: indicates the time length of reviewable trend data. [Slider Icon] can be moved within this time length.
 - [Light Gray Block]: indicates the time length of no trend data. [Slider Icon] cannot be moved within this time length.
 - Different color blocks at the time line indicate events of different types. See the color definition for the event type indicator.
- (5) Event area: displays the event of the cursor time. Selecting the event accesses the event list. If there is no event at the cursor time, the cursor time is displayed.

- (6) Numeric area: displays numeric values at the cursor indicated time. The background color of numeric values matches the alarm priority.
- (7) Cursor
- (8) Slider: indicates the position of current window time in the entire time length. Dragging this button left or right enables you to locate the trend data at a specific time and also refreshes trend data in current window accordingly.
- (9) Button area

16.2.3 Symbols on Review Pages

The following table lists the symbols on review pages.

Symbol	Description
	Slider: indicates the position of current window time in the entire time length. Dragging the slider left or right enables you to locate the trend data at a specific time and also refreshes data in current window accordingly.
	Goes to the previous or next event.
	Event list: displays events in a chronological order. The most recent event is displayed at the top. The number of exclamation symbols before an event matches alarm priority.
	Record button: select it to output animal information and data through the recorder.
	Print button: select it to output animal information and data through the printer.

16.3 Common Operations

This section describes common operations for all review pages.

16.3.1 Browsing Trend Data

To browse trend data, choose any of the following ways:

- Move the cursor.
- Move the slider .
- Slide your finger on the screen.

16.3.2 Viewing Events

To view events, choose either of the following ways:

- Select  and select the desired event.
- Select  or  to view the previous or next event.

16.4 Tabular Trends Review Page

The tabular trends review page displays trend data in a tabular form.

16.4.1 Entering the Tabular Trends Review Page

To enter the **Tabular Trends** review page, choose any of the following ways:

- Select the **Review** quick key → select the **Tabular Trends** tab.
- Select the **Main Menu** hard key or quick key → from the **Review** column select **Tabular Trends**.

16.4.2 Changing the Tabular Trend Group

To change the tabular trend group, follow this procedure:

1. Enter the **Tabular Trends** review page.
2. Set **Trend Group**.

16.4.3 Editing the Tabular Trend Group

The setting of the **Trend Group** defines the contents of displayed and printed trends. To edit the tabular trend group, follow this procedure:

1. Enter the **Tabular Trends** review page.
2. Select **Group Setup** → select the desired tab.

NOTE

- **You cannot edit trend group labeled All or Standard.**
- **ECG parameter and waveform are always displayed in the first row on the trend page. It cannot be deleted or moved.**

16.4.4 Changing the Resolution of Trend Data

The resolution of tabular trends defines the interval of displaying trend data.

To change the interval of trend data, follow this procedure:

1. Enter the **Tabular Trends** review page.
2. Select **Interval**.
 - ◆ **5 sec or 30 sec:** select to view up to 4 hours of tabular trends at an interval of 5 seconds or 30 seconds.
 - ◆ **1 min, 5 min, 10 min, 15 min, 30 min, 1 hr, 2 hrs, or 3 hrs:** select to view up to 120 hours of tabular trends at selected interval.
 - ◆ Select parameters, such as NIBP, C.O. to view the tabular trends when parameter measurements are acquired.

16.4.5 Printing a Tabular Trends Report

To print a tabular trends report, follow this procedure:

1. Enter the tabular trends review page.
2. Select  at the upper left corner of the review page to enter the **Print Setup** menu.
3. Set the tabular trends report as described in *19.6.3 Setting Tabular Trends Reports*.
4. Select **Print**.

16.5 Reviewing the Graphics Trends

The **Graphic Trends** review page displays trend data in a graphic form.

16.5.1 Entering the Graphic Trends Review Page

To enter the **Graphic Trends** review page, choose any of the following ways:

- Select the **Review** quick key → select the **Graphic Trends** tab.
- Select the **Main Menu** hard key or quick key → from the **Review** column select **Graphic Trends**.

16.5.2 Changing the Graphic Trend Group

To change the graphic trend group, follow this procedure:

1. Enter the **Graphic Trends** review page.
2. Set **Trend Group**.

16.5.3 Editing the Graphic Trend Group

The setting of the **Trend Group** defines the contents of displayed and printed trends. To edit the graphic trend group, follow this procedure:

1. Enter the **Graphic Trends** review page.
2. Select  and select **Group Setup**.
3. Select the desired tab.

16.5.4 Changing the Resolution of Trend Data

To change the length of trend data displayed on the current screen, follow this procedure:

1. Enter the **Graphic Trends** review page.
2. Select **Zoom**.
 - ◆ **8 min**: the screen displays eight minutes of trend data. You can view the recent one hour data.
 - ◆ **30 min, 1 hr, 2 hrs, 4 hrs**: the screen displays 30 minutes, one hour, two hours, or four hours of trend data. You can view the recent four hour data.
 - ◆ **8 hrs, 12 hrs, 24 hrs, 48 hrs**: the screen displays eight hours, 12 hours, 24 hours, or 48 hours of trend data. You can view the recent 120 hours of data.

16.5.5 Changing the Number of Waveforms

To change the number of waveforms displayed on the trend review page, follow this procedure:

1. Enter the **Graphic Trends** review page.
2. Select  and select **Trends**.
3. Set **Trends**.

16.5.6 Printing a Graphic Trends Report

Before print a graphic trends report, set the **Graphic Trends** report as described in *19.6.3 Setting Tabular Trends Reports*.

To print a **Graphic Trends** report, follow this procedure:

1. Enter the **Graphic Trends** review page.
2. Select  to enter the **Print Setup** menu.
3. Select **Print**.

16.6 Reviewing Events

The monitor stores events in real time, including technical alarm events, physiological alarm events, manual events, and operational events. When an event occurs, all the measurement numerics and the event-related waveforms 16 seconds before and after the event are stored.

NOTE

- **A total loss of power has no impact on the events stored.**
- **Alarms are saved as events and will be maintained if the equipment is powered down. The time of equipment power down is not recorded as an event and cannot be reviewed.**
- **Earlier events will be overwritten by later ones if the capacity is reached.**

16.6.1 Entering the Events Review Page

To enter the **Events** review page, choose any of the following ways:

- Select the **Review** quick key → select the **Events** tab.
- Select the **Main Menu** hard key or quick key → from the **Review** column select **Events**.

16.6.2 Configuring the Filter

You can filter events to facilitate event review. To configure the filter, follow this procedure:

1. Enter the **Events** page.
2. Select **Filter**. From the drop-down list, select the desired item.

You can customize two criteria. To do so, follow this procedure:

1. From the **Filter** drop-down list, select **Custom 1** or **Custom 2** to enter the **Filter Setup** menu.
2. Select the **Name** field to edit the name of the custom criterion.
3. Select desired items.

If you want to review events happened around certain time, select  → set the time → select **OK**. Then the cursor jumps to the event happened closest to the defined time.

16.6.3 Editing Events

To edit events, follow this procedure:

1. Enter the **Events** page and tick off the desired events.
2. Select  to edit the selected events.
 - ◆ **Lock**: manually lock the event. When the event number reaches its maximum, the locked event will not automatically be deleted by the system.
 - ◆ **Unlock**: unlock the event.
 - ◆ **Delete**: delete the event.
 - ◆ **Note**: enter comments for the event.
 - ◆ **Select All**: select all the events.
 - ◆ **Cancel All**: unselect all the events.
 - ◆ **Show Disabled Arrhythmia Alarms**: this options is disabled by default. Selecting this option displays the arrhythmia events whose alarm switch is turned off.
 - ◆ **Rename**: allow renaming an event name. Only manual events and arrhythmia events can be renamed if enabled by the hospital's settings. For more information, see *20.7 The Review Settings*.

16.6.4 Viewing Event Details

To view waveforms and parameter values at the event time, follow this procedure:

1. Enter the **Events** review page.
2. Select **Detail**.

To display beat labels on the first ECG waveform, switch on **Beat Anno**: The white beat labels indicate heart beats classification and may explain suspected, missed, or false arrhythmia calls. Heart beats are classified as follows:

- N = Normal
- V = Ventricular ectopic
- S = Supraventricular premature
- P = Paced
- L = Learning
- ? = Insufficient information to classify beats
- I = Inoperative (for example, Lead Off)
- M = Missed beat

16.6.5 Printing Event Reports

You can print event reports either via a printer or via a recorder.

To print event reports, follow this procedure:

1. Enter the **Events** review page.
2. Select  or  to enter the **Print Setup** menu.
3. Select the desired options.
 - ◆ **Print All Event List:** print the entire event list.
 - ◆ **Print List of Selected Events:** print the list of selected events.
 - ◆ **Print Detail of Selected Events:** print the details of selected events.
 - ◆ **Print Displayed Event Detail:** print the waveforms and parameters of the currently displayed event.
 - ◆ **Print Overview of Selected Events:** print the overview of selected events.
4. Select **Print**.

16.7 Reviewing Full Disclosure

You can review up to 120-hour waveform data on the **Full Disclosure** review page. You can view both the compressed waveforms and numeric values.

NOTE

- **U drive is required to review full disclosure, that is, you need to plug U drive into the monitor and set the save path for the review data as USB Drive. For details on how to set the save path for the review data, see 20.7.5 The Save Path Tab.**

16.7.1 Entering the Full Disclosure Review Page

To enter the **Full Disclosure** review page, Choose either of the following ways:

- Select the **Review** quick key → select the **Full Disclosure** tab.
- Select the **Main Menu** hard key or quick key → from the **Review** column select **Full Disclosure**.

16.7.2 Selecting Waveforms

Before reviewing compressed waveforms, you must select waveforms you want to store and display. To store and display the desired waveforms, follow this procedure:

1. Enter the **Full Disclosure** review page.
2. Select **Setup** to enter the **Select Waveform** page.
3. Select the **Storage** tab and set the desired waveforms to be stored in the monitor. Select the **Display(Maximum: 3)** tab and set the desired waveforms to be displayed on the **Full Disclosure** page.

NOTE

- **The more waveforms selected in the Storage column, the shorter the waveform storage time. The waveforms may not be stored for 120 hours. Please exert caution when selecting waveforms.**

In case of alarms, the background of compressed waveform at the alarm time is highlighted as follows:

- Red: high alarm priority
- Yellow: medium alarm priority or low alarm priority

16.7.3 Setting the Scale and Duration

To set the length and size of displayed compressed waveforms, follow this procedure:

1. Enter the **Full Disclosure** review page.
2. Select , and then select **Scale** to set ECG waveform gain.
3. Select **Duration** to set the length of displayed waveforms.

16.7.4 Viewing Details of Compressed Waveforms

To view the full waveforms and numeric values, follow this procedure:

1. Enter the **Full Disclosure** review page.
2. Select **Detail**.

You can perform the following operations on this page:

- Switch on **Beat Anno.** For more information, see *16.6.4 Viewing Event Details*.
- Select  and set **Speed** and **ECG Gain**, or **Save As Event**.
- Select **Overview** to switch to the compressed waveform page.

16.7.5 Printing the Full Disclosure Waveform Report

To print a compressed waveform report, follow this procedure:

1. Enter the **Full Disclosure** review page.
2. Select  and set the time range for printing.
3. Select **Print**.

16.8 ST Review Page

When ST analysis is enabled, the monitor saves ST segments and values at an interval of five minutes. You can review the latest 120 hours of ST data.

16.8.1 Entering the ST Review Page

To enter the ST review page, choose either of the following ways:

- Select the **Review** quick key → select the **ST** tab.
- Select the **Main Menu** hard key or quick key → from the **Review** column select **ST**.

16.8.2 Setting the ST Reference

You can set the currently displayed ST as reference. To do so, follow this procedure:

1. Enter the ST review page.
2. Select **Set Reference**.

NOTE

- The ST baseline is used as ST reference by default.

16.8.3 Displaying/Hiding the ST Reference

To display or hide ST reference, follow this procedure:

1. Enter the ST review page.
2. Select **Display Reference** or **Hide Reference**.

16.8.4 Displaying/Hiding Markers

To display or hide markers, follow this procedure:

1. Enter the ST review page.
2. Select **Display Marker** or **Hide Marker**.

16.8.5 Printing ST Data

To print ST data, follow this procedure:

1. Enter the ST review page.
2. Select .

16.9 Reviewing Discharged Animals

For discharged animals, you can review the trend data in the review page and the events.

16.9.1 Checking the Data of a Discharged Animal

1. Access the **Discharged Patients** dialog box by either of the following ways:
 - ◆ Select the **Discharged Patients** quick key. If viewing discharged animals is password protected, input the user name and password (the user password saved in the MLDAP server).
 - ◆ Select the **Main Menu** hard key or quick key → from the **Patient Management** column select **Discharged Patients**. If viewing discharged animals is password protected, input the user name and password ((the user password saved in the MLDAP server).
2. From the animal list select the desired animal.
3. Select **Detail**. If reviewing animal data is password protected, input the monitor's clinical password (local password).

16.9.2 Checking the Information of a Discharged Animal

1. Access the **Discharged Patients** dialog box by either of the following ways:
 - ◆ Select the **Discharged Patients** quick key. If viewing discharged animals is password protected, input the user name and password (the user password saved in the MLDAP server).
 - ◆ Select the **Main Menu** hard key or quick key → from the **Patient Management** column select **Discharged Patients**. If viewing discharged animals is password protected, input the user name and password (the user password saved in the MLDAP server).
2. From the animal list select the desired animal.
3. Select **Detail**. If reviewing animal data is password protected, input the monitor's clinical password (local password).
4. Select the  icon to enter the **Patient Information** dialog box.

17 Auxiliary Function

17.1 Auxiliary Function Overview

The Auxiliary Function integrates some commonly used clinical guidelines and tools into the monitor. It puts the currently monitoring parameter measurements together and provides comprehensive analysis results.

The Auxiliary Function is not intended to replace the competent judgment of a clinician. It must be used in conjunction with observation of clinical signs and symptoms.

17.2 ECG 24h Summary

The ECG 24h Summary provides ECG statistics of the current animal over the latest 24 hours. It also displays the animal's typical ECG strips.

NOTE

- The ECG 24h Summary function is intended for the current animal. It is not intended for discharged animals.
- Pacer statistics is intended for paced animals. Pacer statistics is available only when the Paced setting is Yes.
- ST statistics is available only when ST analysis is switched on.
- QT statistics is available only when QT analysis is switched on.
- Data displayed in the ECG 24h Summary is not recalculated.

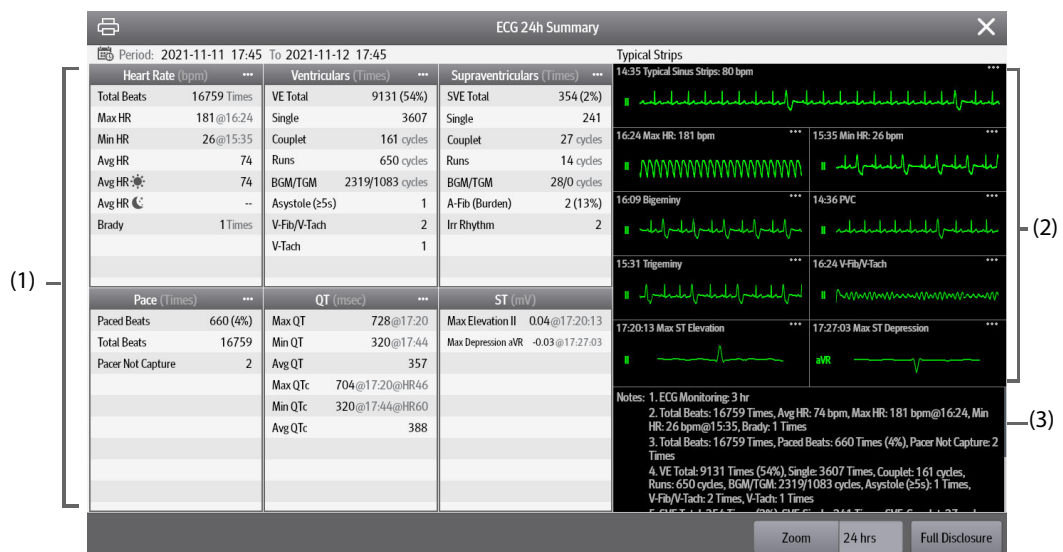
17.2.1 Opening the ECG 24h Summary Window

To open the ECG 24h Summary window, choose either of the following ways:

- Select the **ECG 24h Sum** quick key.
- Select the **Main Menu** hard key or quick key → from the **Auxiliary Function** column select **ECG 24h Summary**.

17.2.2 The Display of ECG 24h Summary

The following figure is an example of the ECG 24h Summary window:



(1)	ECG statistics, including the following items: Statistics of heart rates Statistics of ventricular beats and ventricular events Statistics of supraventricular beats and supraventricular events Statistics of QT/QTc measurements Statistics of maximum ST elevations and depressions Statistics of pace
(2)	Typical ECG strips
(3)	Notes: includes additional information on the ECG 24h Summary

17.2.3 Selecting Typical ECG Strips

Taking V-Tach as an example, to select typical V-Tach waveform, select the currently displayed V-Tach waveform, from the popup list select the desired waveform as typical V-Tach waveform.

If no V-Tach occurs to the animal within 24 hours, an add symbol  is displayed in the V-Tach area. You can select the add symbol to display a typical ECG waveform of other event in this area.

17.2.4 Setting the Statistical Duration of the ECG 24h Summary

You can view a maximum of 24 hours of ECG statistics through the ECG 24h Summary. To select the statistical duration, select **Zoom**.

17.2.5 Reviewing the ECG Summary

Selecting any of the statistic area can access corresponding trends and events review. Selecting **Full Disclosure** can review ECG full disclosure waveforms. For more information, see *16 Review*.

17.3 Calculation

WARNING

- **Drug calculations are basing on input values. Always check the correctness of input parameters and the appropriateness of the calculations. Choice and dosage of drugs administered to animals must be decided by the physician in charge.**
- **Check that the entered values are correct and the calculated values are appropriate. We assume no responsibility for any consequences caused by wrong entries and improper operations.**

The monitor provides calculation functions. The calculated values, which are not directly measured, are computed based on the values you provide. The calculation feature is independent of other monitoring functions and can be therefore used for animals being monitored by other monitors. Any operation in a calculation window does not affect the animal monitored by the current monitor.

You can perform the following calculations:

- Drug calculations
- Hemodynamic calculations

17.3.1 Drug Calculations

The monitor provides the drug calculation function.

17.3.1.1 Performing Drug Calculations

To perform drug calculations, follow this procedure:

1. Access drug calculator by either of the following ways:
 - ◆ Select the **Calculations** quick key → select **Drug** tab.

- ◆ Select the **Main Menu** hard key or quick key → from the **Auxiliary Function** column select **Calculations** → **Drug**.
- 2. Set **Drug Name**. If the dose of drug is weight dependent, you must input the animal's weight. The dose calculation program has a library of commonly used drugs, of which Drug A through Drug E are user defined.
- 3. Enter the known values, for example **Drug Amount** and **Solution Volume**.
- 4. Select **Calculate**. The calculated values are indicated by red arrows.

NOTE

- If available, the species and weight from the Animal Information menu are automatically entered when you first access drug calculation. You can change the species and weight. This will not change the species and weight stored in the animal demographic information.

17.3.1.2 Checking the Titration Table

The titration table shows information on the currently used drugs. Use the titration table to see what dose of a drug your animal will receive at different infusion rates. To access the titration table, follow this procedure:

1. Access drug calculator by either of the following ways:
 - ◆ Select the **Calculations** quick key.
 - ◆ Select the **Main Menu** hard key or quick key → from the **Auxiliary Function** column select **Calculations** → **Drug**.
2. Select the **Titration Table** tab.
3. Select **Dose Type** to set the type of dose unit in the titration table.
4. Select **Interval** to set the interval between two adjacent titration table items.

You can select how to display the titration table:

- **Dose**: the titration table is listed in the sequence of increased drug dose.
- **Infusion Rate**: the titration table is listed in the sequence of increased infusion rate. Normally the resolution of the infusion rate is one (1). By selecting **Exact Rate** the resolution of the infusion rate can reach 0.01 so that you can display the infusion rate more accurately.

17.3.1.3 Drug Calculation Formula

Description	Unit	Formula
Dose	Dose/hr Dose/min	$\text{Dose} = \text{Infusion Rate} \times \text{Concentration}$
Dose (weight based)	Dose/kg/hr Dose/kg/min	$\text{Dose (weight based)} = \text{Infusion Rate} \times \text{Concentration} / \text{Weight}$
Drug Amount	g series: mcg, mg, g unit series: Unit, KU, MU mEq series: mEq	$\text{Drug Amount} = \text{Dose} \times \text{Duration}$
Drug Amount (weight based)	g series: mcg, mg, g unit series: Unit, KU, MU mEq series: mEq	$\text{Drug Amount (weight based)} = \text{Dose} \times \text{Duration} \times \text{Weight}$
Duration	hr	$\text{Duration} = \text{Amount} / \text{Dose}$
Duration (weight based)	hr	$\text{Duration (weight based)} = \text{Amount} / (\text{Dose} \times \text{Weight})$
Concentration	mcg/ml, mg/ml, g/ml, Unit/ml, KU/ml, MU/ml, mEq/ml	$\text{Concentration} = \text{Drug Amount} / \text{Solution Volume}$
Solution volume	ml	$\text{Volume} = \text{Infusion Rate} \times \text{Duration}$

Description	Unit	Formula
Infusion rate	ml/hr	Infusion Rate = Dose/Concentration
Infusion rate (weight based)	g-ml/hr	Infusion Rate = Dose × Weigh/Concentration

17.3.1.4 Titration Table Calculation Formula

Description	Unit	Formula
Infusion Rate	ml/hr	Infusion Rate = Dose/Concentration
Infusion Rate (weight based)	ml/hr	Infusion Rate = Weight × Dose/Concentration
Dose	Dose/hr Dose/min	Dose = Infusion Rate × Concentration
Dose (weight based)	Dose/kg/hr Dose/kg/min	Dose (weight based) = INF Rate × Concentration/ Weight

17.3.2 Hemodynamic Calculations

The monitor provides the hemodynamic calculation function. The monitor can save the results of up to 10 calculations, which are displayed in groups.

17.3.2.1 Performing Hemodynamic Calculations

To perform hemodynamic calculation, follow this procedure:

- Access hemodynamic calculation by either of the following ways:
 - ◆ Select the **Calculations** quick key → **Hemodynamics** tab.
 - ◆ Select the **Main Menu** hard key or quick key → from the **Auxiliary Function** column select **Calculations** → **Hemodynamics**.
- Enter the known values. For an animal who is being monitored, the currently measured values are automatically taken.
- Select **Calculate**.

The calculated value greater than the normal upper limit is indicated by an up arrow “↑”. The calculated value lower than the normal lower limit is indicated by a down arrow “↓”.

You can select **Range** to show the normal range of each parameter.

17.3.2.2 Input Parameters for Hemodynamic Calculations

Input Parameter	Label	Unit
cardiac output	C.O.	L/min
heart rate	HR	bpm
pulmonary artery wedge pressure	PAWP	mmHg
artery mean pressure	PMAP	mmHg
pulmonary artery mean pressure	PA-M	mmHg
central venous pressure	CVP	mmHg
end-diastolic volume	EDV	ml
length	Length	cm
weight	Weight	kg

NOTE

- If you enable Use PA-D as PAWP, PA-D value will be used to replace PAWP value for hemodynamic calculation. For more information, see 13.6.5 Setting the Use PA-D as PAWP Switch.

17.3.2.3 Calculated Parameters and Formulas for Hemodynamic Calculations

Calculated Parameters	Label	Unit	Formula
cardiac index	C.I.	L/min/m ²	$C.I. (L/min/m^2) = C.O. (L/min)/BSA (m^2)$
body surface area	BSA	m ²	$BSA (m^2) = K \times Wt^{2/3} (g) / 10000$ among them, for K: feline= 9.9 canine=11.2
stroke volume	SV	ml	$SV (ml) = 1000 \times C.O. (L/min)/HR (bpm)$
stroke index	SVI	ml/m ²	$SVI (ml/m^2) = SV (ml)/BSA (m^2)$
systemic vascular resistance	SVR	DS/cm ⁵	$SVR (DS/cm^5) = 79.96 \times [PAMAP (mmHg) - CVP (mmHg)]/C.O. (L/min)$
systemic vascular resistance index	SVRI	DS•m ² /cm ⁵	$SVRI (DS \cdot m^2/cm^5) = SVR (DS/cm^5) \times BSA (m^2)$
pulmonary vascular resistance	PVR	DS/cm ⁵	$PVR (DS/cm^5) = 79.96 \times [PAMAP (mmHg) - PAWP (mmHg)]/C.O. (L/min)$
pulmonary vascular resistance index	PVRI	DS•m ² /cm ⁵	$PVRI (DS \cdot m^2/cm^5) = PVR (DS/cm^5) \times BSA (m^2)$
left cardiac work	LCW	kg•m	$LCW (kg \cdot m) = 0.0136 \times PAMAP (mmHg) \times C.O. (L/min)$
left cardiac work index	LCWI	kg•m/m ²	$LCWI (kg \cdot m/m^2) = LCW (kg \cdot m)/BSA (m^2)$
left ventricular stroke work	LVSW	g•m	$LVSW (g \cdot m) = 0.0136 \times PAMAP (mmHg) \times SV (ml)$
left ventricular stroke work index	LVSWI	g•m/m ²	$LVSWI (g \cdot m/m^2) = LVSW (g \cdot m)/BSA (m^2)$
right cardiac work	RCW	kg•m	$RCW (kg \cdot m) = 0.0136 \times PAMAP (mmHg) \times C.O. (L/min)$
right cardiac work index	RCWI	kg•m/m ²	$RCWI (kg \cdot m/m^2) = RCW (kg \cdot m)/BSA (m^2)$
right ventricular stroke work	RVSW	g•m	$RVSW (g \cdot m) = 0.0136 \times PAMAP (mmHg) \times SV (ml)$
right ventricular stroke work index	RVSWI	g•m/m ²	$RVSWI (g \cdot m/m^2) = RVSW (g \cdot m)/BSA (m^2)$
ejection fraction	EF	%	$EF (\%) = 100 \times SV (ml)/EDV (ml)$
End-diastolic volume index	EDVI	ml/m ²	$EDVI (ml/m^2) = EDV (ml)/BSA (m^2)$
End-systolic Volume	ESV	ml	$ESV (ml) = EDV (ml) - SV (ml)$
End-systolic Volume index	ESVI	ml/m ²	$ESVI (ml/m^2) = ESV (ml)/BSA (m^2)$

17.4 ECG Library

NOTE

- Due to the individual animal differences, the real-time waveform of the animal may not be completely consistent with the ECG reference waveforms, and the ECG reference waveforms are only for reference.

ECG Library screen is displayed on the left of the screen, displaying the following:

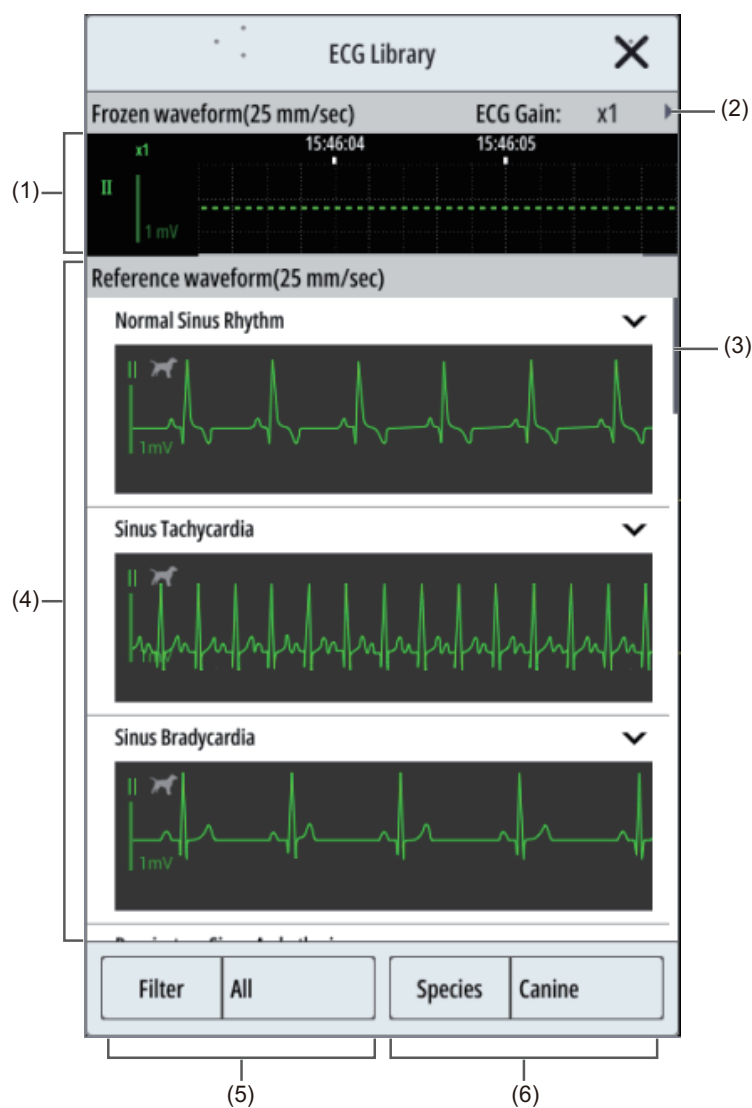
- ECG waveform within the first minute after entering the ECG library menu.
- ECG reference waveforms and characteristics description.

17.4.1 Entering the ECG Library Screen

Use any of the following methods to enter the ECG Library screen:

- Select the **Main Menu** hard key or quick key → from the **Auxiliary Function** column select **ECG Library**.
- Select the ECG numeric area or waveform area to enter the ECG menu → **ECG Library** button.
- Select the **ECG Library** quick key.

17.4.2 The Display of ECG Library



- (1) Frozen waveform: displays ECG waveform with the speed of 25mm/s within 1 minute from entering the ECG library menu. Swipe from left to right or right to left across the frozen waveform area to view the frozen waveform.
- (2) ECG gain: you can set the ECG gain in the frozen waveform area.
- (3) Scroll bar: swipe up and down on the reference waveform area to view reference waveforms.
- (4) Reference waveform: display reference waveforms with the speed of 25mm/s. Each waveform name is displayed in the upper left corner of its waveform fragment. Click "v" to display the waveform characteristics.
- (5) Filter button: click to filter the reference waveforms according to the type.
- (6) Species button: click to filter the reference waveforms according to the species.

17.5 CO₂ Library

NOTE

- **Due to the individual animal differences, the real-time waveform of the animal may not be completely consistent with the CO₂ reference waveforms, and the CO₂ reference waveforms are only for reference.**
- **This monitor only provides common causes of CO₂ waveform abnormalities. Please make a comprehensive judgment based on the actual clinical situation.**

CO₂ library screen is displayed on the left of the screen, displaying the following:

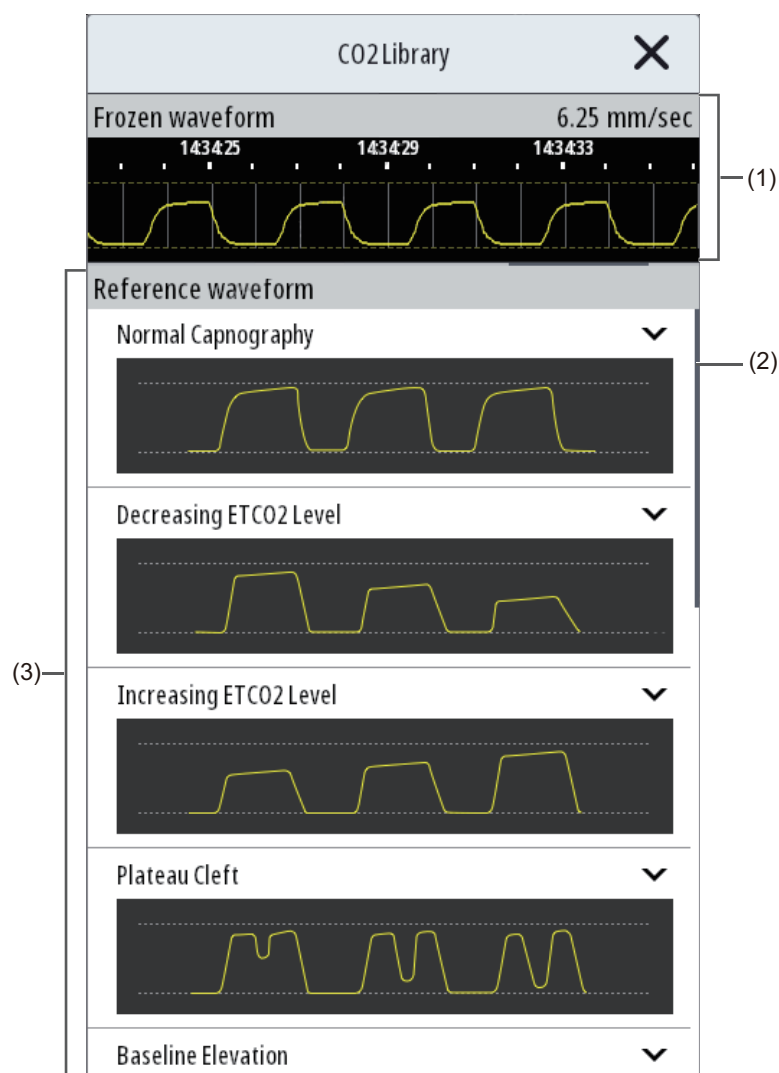
- CO₂ waveform within first minute after entering the CO₂ library menu.
- CO₂ reference waveforms and possible causes for abnormal waveform.

17.5.1 Entering the CO₂ Library Screen

Use any of the following methods to enter the CO₂ Library screen:

- Select the **Main Menu** hard key or quick key → from the **Auxiliary Function** column select **CO₂ Library**.
- Select the CO₂ numeric area or waveform area to enter the CO₂ menu → **CO₂ Library** button.
- Select the **CO₂ Library** quick key.

17.5.2 The Display of CO₂ Library



- (1) Frozen waveform: displays CO₂ waveform with the speed of 6.25mm/s within 1 minute from entering the CO₂ library menu. Swipe from left to right or from right to left across the frozen waveform area to view the frozen waveform.
- (2) Scroll bar: swipe up and down on the reference waveform area to view reference waveforms.
- (3) Reference waveform: each waveform interpretation is displayed on the upper left corner of its waveform fragment. Click "v" to display the description of abnormal waveforms.

17.6 Stages of Anesthesia

Stages of anesthesia screen displays the following:

- HR, RR and NIBP trend graphic.
- Provides stage of anesthesia chart so that the medical staff can easily evaluate the anesthetic depth for the animal.

17.6.1 Entering Stages of Anesthesia Screen

Use any of the following methods to enter the stages of anesthesia screen:

- Select the **Main Menu** hard key or quick key → from the **Auxiliary Function** column select **Stages of Anesthesia**.

- Select **Stages of Anesthesia** quick key.

17.6.2 Stages of Anesthesia Chart

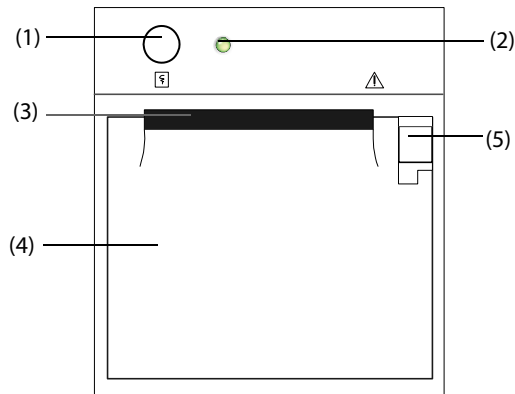
Stages of Veterinary Anesthesia	Jaw Tone	Palpebral reflex	Eyeball Position & Pupil size	Pupillary Light Response	Response to Surgery
Plane1		+		Yes	May respond with movement
Plane2		—		Sluggish	HR and RR may increase
Plane3		—		Very sluggish or absent	None
Plane4		—		Unresponsive	None

18 Recording

18.1 Recorder

The thermal recorder records animal information, measurement data, and up to three waveforms.

The monitor is configured with a built-in recorder.



- (1) Start/Stop key: press to start a recording or stop the current recording.
- (2) Module status indicator
 - ◆ On: when the recorder works correctly.
 - ◆ Off: when the monitor is switched off.
 - ◆ Flashes: if an error occurred to the recorder.
- (3) Paper outlet
- (4) Recorder door
- (5) Latch: pull it backward to open the recorder door.

18.2 Starting Recordings

Recordings can be started manually or automatically.

18.2.1 Manually Starting Recordings

To manually start a recording, you can either:

- Press the  hardkey on the front of the recorder.
- Select  on the current page.

18.2.2 Automatic Recordings

In the following conditions, you can set the recorder to automatically start recording:

- At a preset interval. For more information, see *18.5 Setting the Recorder*.
- When a parameter alarm is triggered. For more information, see *18.6 Enabling Auto Recording on Alarm*.

18.3 Stopping Recordings

Recordings can be stopped manually or automatically.

18.3.1 Stopping Recordings Manually

To manually stop a recording, choose either of the following method:

- Press the  hardkey again.
- Select **Clear All Record Tasks** in the **Record Setup** menu.

18.3.2 Stopping Recordings Automatically

Recordings stop automatically in the following conditions:

- The recording is completed.
- The recorder runs out of paper.
- The recorder has an alarm condition.

18.4 Recording Related Flags

You can find the following flags on the recording reports:

- For automatically stopped recordings, there are two columns of asterisks "*" at the end of the report.
- For manually or abnormally stopped recordings, there is one column of asterisks "*" at the end of the report.

18.5 Setting the Recorder

To set the recorder, follow this procedure:

1. Select the **Main Menu** hard key or quick key → from the **Report** column select **Record Setup**.
2. In the **Record Setup** menu, select the desired waveform for **Waveform 1**, **Waveform 2** and **Waveform 3** in turn. The recorder can record up to 3 waveforms at a time.
3. Switch on or off **IBP Overlap** to enable or disable IBP recordings in the overlapping format.
 - ◆ When the **IBP Overlap** is enabled: If two or more waveforms in the selected waveforms for recording are IBP waveforms, the IBP waveforms will be recorded in the overlapping format.
 - ◆ When the **IBP Overlap** is disabled: IBP waveforms will be recorded normally.
4. Select **Recording Duration** to set the duration of real-time recording.
5. Select **Interval** to set the time interval for automatic recording.
6. Select **Recorder Paper Speed** to set the speed for recording waveforms.

18.6 Enabling Auto Recording on Alarm

To initiate automatic recording via recorder when a parameter alarm is triggered, follow this procedure:

1. Access the **Alarm** menu for the desired parameter in one of the following ways:
 - ◆ Select the **Alarm Setup** quick key at the bottom of the screen.
 - ◆ Select the numerics area or waveform area of the desired parameter → select the **Alarm** tab.
 - ◆ Select the **Parameters Setup** quick key → select the desired parameter → select the **Alarm** tab.
2. Switch on **Alarm Outputs**.

NOTE

- **Auto recording on alarm happens only when Print on Alarm is set to Recorder. For more information, see 20.11 The Other Settings.**

18.7 Clearing Recording Tasks

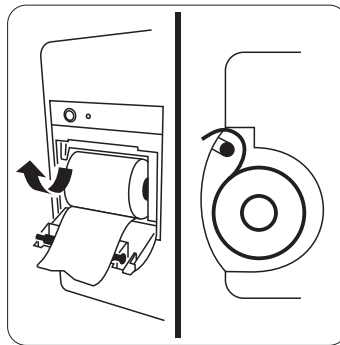
To clear recording tasks, follow this procedure:

1. Select the **Main Menu** hard key or quick key → from the **Report** column select **Record Setup**.
2. In the **Record Setup** menu, select **Clear All Record Tasks**. This clears all queued recording tasks and stops the current recording.

18.8 Loading Paper

To load paper, follow this procedure:

1. Pull the latch on the upper right of the recorder to open the recorder door.
2. Insert a new roll into the compartment as shown below. Feed the paper through and pull some paper out from the top of the roller.
3. Close the recorder door.



CAUTION

- **Use only specified thermal paper. Otherwise, it may cause damage to the recorder's printhead, the recorder may be unable to print, or poor print quality may result.**
 - **Never pull the recorder paper with force when a recording is in process. Otherwise, it may cause damage to the recorder.**
 - **Do not leave the recorder door open unless you reload paper or remove troubles.**
-

18.9 Removing Paper Jam

If the recorder works incorrectly or produces unusual sounds, check if there is a paper jam first. If a paper jam is detected, follow this procedure to remove it:

1. Open the recorder door.
2. Take out the paper and tear off the draped part.
3. Reload the paper and close the recorder door.

19 Printing

The monitor can output animal reports via network printer or printer server.

19.1 Supported Printer

The monitor supports the following printer:

- HP LaserJet Pro M202dw
- HP LaserJet Enterprise M605
- HP LaserJet P4015n
- HP LaserJet Pro 400 M401n
- HP LaserJet 600 M602
- HP LaserJet Enterprise M608
- HP LaserJet Pro M203dw
- HP LaserJet Pro M203dn

NOTE

- **For more details about the printer, see the document accompanying the printer. With product upgrades, the monitor may support more printers and no prior notice will be given. If you have any doubt about the printer you have purchased, contact the Customer Service Department or your local distributor.**

19.2 End Case Reports

19.2.1 Printing the End Case Report

To print the end case report, choose one of the following ways:

- Select **Print** from the **End Case Report** menu.
- Select **Print End Case Report** when you discharge an animal
- Select the **End Case Report** quick key.

19.2.2 Setting a Report as An End Case Report

The following reports can be set as end case reports:

- Tabular Trends Report
- Graphic Trend Report
- Event Report
- Alarm Limits Report
- Realtime Report
- ECG Report
- ECG Summary

To set a report as an end case report, follow this procedure:

1. Select the **Main Menu** hard key or quick key → from the **Report** column select **End Case Report**.
2. From the **Select Reports** page, select the checkbox before the desired report, for example **ECG Report**.

19.2.3 Setting the End Case Report

To set the end case report, follow this procedure:

1. Select the **Main Menu** hard key or quick key → from the **Report** column select **End Case Report**.
2. From the **Report Setup** page, set the following end case reports:
 - ◆ Select the **Tabular Trends Report**, **Graphic Trends Report**, **Realtime Report**, and **ECG Report** tab, and set these end case report by referring to section *19.6 Setting Reports*.
 - ◆ Select the **Event Report** tab, and select the event that needs to be printed.

19.2.4 Setting the End Case Report Period

To set the end case report print period, follow this procedure:

1. Select the **Main Menu** hard key or quick key → from the **Report** column select **End Case Report**.
2. From the **Select Reports** page, set the **Period**.

NOTE

- End case report print period is calculated from the animal discharged time to the configured period.
- Period setting is applicable to all the end case report.

19.3 Manually Starting a Printing Task

You can start a printing task manually.

19.3.1 Starting Printing from the Current Page

From the current page, select , if available, to start printing.

19.3.2 Printing Realtime Reports

Select  to print a realtime report. You can also print a realtime report from the **Report Setup** page. For more information, see *19.3.3 Printing General Reports*.

19.3.3 Printing General Reports

You can print the following general reports:

- ECG Report
- Realtime Report
- Tabular Trends Report
- Graphic Trend Report

To print the general reports, follow this procedure:

1. Select the **Main Menu** hard key or quick key → from the **Report** column select **Report Setup**.
2. Select the desired report tab.
3. Check the settings.
4. Select **Print**.

19.4 Automatically Printing Reports

When a parameter alarm switch is set to on and an alarm is triggered for this parameter, you can set a printer to start alarm printing automatically.

To do so, follow this procedure:

1. Access alarm related tabs such as the **Alarm** tab for a parameter in one of the following ways:
 - ◆ Select the **Alarm Setup** quick key.
 - ◆ Select the parameter or waveform area of the desired parameter → select the **Alarm** tab.
 - ◆ Select the **Parameters Setup** quick key → select the desired parameter → select the **Alarm** tab.
 - ◆ Select the **Main Menu** quick key → from the **Parameters Setup** column select **Setup** → select the desired parameter → select the **Alarm** tab.
2. Switch on **Alarm Outputs** for desired parameters.

19.5 Stopping a Printing Task

To stop a printing task, follow this procedure:

1. Select the **Main Menu** hard key or quick key → from the **Report** column select **Print Queue**.
2. Select desired printing tasks and then select **Delete**. Selecting **Delete All** to stop all the printing tasks.

19.6 Setting Reports

This section focuses on how to set ECG reports, realtime reports, tabular trends reports, and graphic trends reports.

19.6.1 Setting ECG Reports

To set ECG reports, follow this procedure:

1. Select the **Main Menu** hard key or quick key → from the **Report** column select **Report Setup**.
2. Select **ECG Report**.
3. Set the desired options. The following table only lists some of the options.

Menu item	Function	Description
Speed	Set the print speed of ECG waveforms	25 mm/sec: prints 25 mm of ECG waveform per second. 50 mm/sec: prints 50 mm of ECG waveform per second.

NOTE

- When Lead Set is set to 3-Lead, the ECG report cannot be printed.

19.6.2 Setting Realtime Reports

To set tabular realtime reports, follow this procedure:

1. Select the **Main Menu** hard key or quick key → from the **Report** column select **Report Setup**.
2. Select **Realtime Report**.
3. Set the desired options. The following table only lists some of the options.

Menu item	Function	Description
Select Waveform	Select the desired waveform to print	Current Waveforms: prints the realtime report for current waveforms. Selected Waveforms: prints the realtime report for the selected waveforms.

19.6.3 Setting Tabular Trends Reports

To set tabular trends reports, follow this procedure:

1. Select the **Main Menu** hard key or quick key → from the **Report** column select **Report Setup**.
2. Select **Tabular Trends Report**.
3. Set the desired options. The following table only lists some of the options.

Menu Item	Function	Description
Period	Select the period during which a tabular trends report will be printed.	Auto: one page of a tabular trends before the current time will be printed at the selected Interval . All: all stored tabular trends will be printed at the selected Interval . 30 min to 96 hrs: 30 min to 96 hrs of tabular trends before the selected Time will be printed at the selected Interval .
Interval	Select the resolution of the tabular trends printed on a report.	NIBP, C.O.: at an interval of acquiring the values of selected parameter. Auto: using the Interval setting of the Tabular Trends review page. 5 sec to 3 hrs: the tabular trends will be printed at the selected Interval .
Report Format	Select the printing principle.	Landscape: parameter values are listed vertically and trend time is listed horizontally. Portrait: trend time is listed vertically and parameter values are listed horizontally.

19.6.4 Setting Graphic Trends Reports

To set graphic trends reports, follow this procedure:

1. Select the **Main Menu** hard key or quick key → from the **Report** column select **Report Setup**.
2. Select the **Graphic Trends Report** tab.
3. Set the desired options.

Menu Item	Function	Description
Period	Select the period during which a graphic trends report will be printed.	Auto: one page of a graphic trends before the current time will be printed. All: all stored graphic trends will be printed. 30 min to 96 hrs: 30 min to 96 hrs of graphic trends before the selected Time will be printed.

19.7 Viewing Printer Status

You can view the status of the recent ten printing tasks in the **Print Queue** window. To view the status of printing tasks, select the **Main Menu** hard key or quick key, from the **Report** column select **Print Queue**.

Each printing task includes the following information:

- Print time
- Report title
- Printer name (when using the printer server) or IP address (when using the network printer)
- Printing status, for example, printing, failed, retrying, and waiting.

19.8 Printer Out of Paper

When the printer runs out of paper, the print request will not be responded. If there are too many print jobs that are not responded, a printer error may occur. In these cases, you need to install paper and then re-send the print request. Restart the printer if necessary.

Therefore, you'd better ensure that there is enough paper in the printer before sending a print request.

20 User Maintenance Settings

20.1 User Maintenance Introduction

User maintenance enables you to customize your equipment to best meet your needs. Accessing the **Maintenance** menu is password protected.

CAUTION

- The maintenance settings can only be changed by authorized personnel.
-

20.2 Accessing the Maintenance Menu

To perform user maintenance, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select Enter key.
2. Select desired tab.

20.3 The Device Location Settings

Menu Item	Default Setting	Description
Monitor Name	/	/
Facility		
Department		
Room No.	/	/
Bed No.		
Location	Fixed	• Fixed: the Patient Information menu displays Bed No. and Room No., but you cannot change them. • Unfixed: you can change Bed No. and Room No. from the Patient Information menu. Bed No. and Room No. are cleared each time you discharge an animal.
Auto Obtain Bed No.	Off	On: if the monitor is connected to the wired network, the monitor automatically sets the animal's bed number according to the bed number information bonded to the bedside network connector. The Auto Obtain Bed No. function is available only when the switch connected to the monitor supports the LLDP or CDP protocol, and the corresponding protocol is enabled.

20.4 The Animal Management Settings

20.4.1 The Field Tab

Menu Item	Default Setting	Description
Room No	Unselected	Selects which items can be displayed and edited from the Patient Information menu.
Patient ID	Selected	
Visit Number	Unselected	
Breed	Unselected	
Length	Selected	
Custom Field 1- Custom Field 3	Unselected	

NOTE

- If the monitor is connected with the CMS, the animal information items and customized fields are loaded from the CMS.

20.4.2 The Discharge Tab

Menu Item	Default Setting	Description
Auto delete discharged patients when storage space is full	On	/
Prompt on patient auto deleted	On	On: an alarm is issued when the monitor automatically deletes earlier discharged animals.
Prompt Alarm When Storage Is Nearly Full	Med	Selects whether an alarm is issued when the monitor memory is very low and the priority of this alarm.
Include Patient Demographics When Exporting Patient Data	Off	Selects whether animal demographics is included when exporting the animal data.
Auto Delete Patient Data if Discharged	Auto	Selects whether animal data is deleted when the animal is discharged. • Auto: not delete animal data when the animal is discharged. Discharged animal will be deleted when the storage space of the monitor is full. • Right Now: deletes animal data as soon as the animal is discharged. • 7 days: deletes animal data seven days after the animal is discharged. • 1 Month: deletes animal data one month after the animal is discharged.
Clear All Patient Data	/	Deletes all animal information and data. Clearing animal data will discharge the current animal.

20.4.3 The Display Tab

Menu Item	Default Setting	Description
Primary Screen Display Full Name	On	Selects whether animal name is displayed in the animal information area on the primary display.
Primary Screen Display Full Patient ID	Off	When this option is set on, animal ID is displayed on the alarm/prompt area on the main screen. This function works only when Enhanced Patient Information is switched on.

Menu Item	Default Setting	Description
Enhanced Patient Information	Off	When this option is on and the monitor has only non-exclusive physiological alarms or is in no alarms/prompts or is in standby status, the animal information is enhanced to display.

20.5 The Alarm Settings

20.5.1 The Audio Tab

Menu Item	Default Setting	Description
Minimum Alarm Volume	2	/
Alarm Sound	ISO	Defines the alarm tone pattern to distinguish the heart beat tone, pulse tone, and keystroke tone by frequency.
High Alarm Interval	10 sec	Defines the interval between alarm tones for the ISO mode.
Med Alarm Interval	20 sec	
Low Alarm Interval	20 sec	
Auto Increase Volume	2 Steps	• 2 Steps: if an alarm is not reset within the designated delay time after the alarm occurs, the alarm volume automatically increases by two levels. • 1 Step: if an alarm is not reset within the designated delay time after the alarm occurs, the alarm volume automatically increases by one level. • Off: if an alarm is not reset within the designated delay time after the alarm occurs, the volume of the alarm tone does not change.
Increase Volume Delay	20 sec	Defines the delay time of alarm volume escalation.

NOTE

- **The alarm volume escalation function is not applied to the latched alarms.**

20.5.2 The Pause/Reset Tab

Section	Menu Item	Default Setting	Description
Pauses	Pause	Alarm Pause	Selects the pause function. • Alarm Pause: pauses alarms. • Audio Pause: pauses alarm tones.
	Pause Time	2 min	Selects the alarm pause time. The alarm pause time can be set to 1 min, 2 min, 3 min, or Permanent.
	Pause Priority	All	Selects alarms of what priority can be paused. • All: pressing the Alarm Pause quick key pauses all alarms. • Med & Low: pressing the Alarm Pause quick key pauses alarms of medium and low priority. The high priority alarms will not be paused. • Disabled: the Alarm Pause quick key is disabled.
	Pause 5 min	Off	Selects how long the alarm can be paused if switched on.
	Pause 10 min	Off	
	Pause 15 min	Off	
Alarm Reset	Alarm Light	On When Reset	• On When Reset: when the alarm system is reset, the alarm tones of the current alarms are switched off, but the alarm lamp remains flashing. • Off When Reset: when the alarm system is reset, both the alarm tone and alarm lamp of the current alarms are switched off.
Reminder Tone	Alarm Reset Reminder	On	Selects the reminder tone rule when the alarm volume is set to zero, or the alarm is reset or switched off. • On: the monitor issues reminder tones at a designated interval. • Re-alarm: if the alarm condition persists, the alarms marked with "√" will be regenerated after the designated reminder tone interval. • Off: the monitor does not issue reminder tones at a designated interval. The alarms marked with "√" will be silenced.
	Alarm Off Reminder	On	/
	Reminder Interval	5 min	• 10 min: the monitor issues reminder tones every 10 minutes. • 5 min: the monitor issues reminder tones every five minutes. • 3 min: the monitor issues reminder tones every three minutes. • 2 min: the monitor issues reminder tones every two minutes. • 1 min: the monitor issues reminder tones every one minute.

20.5.3 The Latching Tab

Menu Item		Default Setting	Description
Lethal	Visible	Unselected	Selects alarm latching rules: - If Visible is selected, you can separately latch visual alarm signal. - Latching audible alarm signal simultaneously latches visual signal. - Selecting alarms of lower priority simultaneously latches higher priority alarms.
	Audible		
High	Visible		
	Audible		
Med	Visible		
	Audible		
Low	Visible		
	Audible		

20.5.4 Trend Alarm

Menu Item	Description
Check box	Select the alarm displayed in the trend alarm settings menu and the configured alarm can be set.
Name	Select the alarm name to change the default name of corresponding alarm.
Icon Type	You can only select icon type of a custom trend alarm.
Notification	- Only Alarm: when a combined alarm occurs, alarm message is displayed in the physiological alarm area. - Only Popup: when a combined alarm occurs, the Patient Status window pops up. - Alarm+Popup: when a combined alarm occurs, alarm message is displayed in the physiological alarm area and the Patient Status window pops up.
Delay	Set the default delay of the combined alarm.
Combined Alarm Refractory Period	In the refractory period, the alarm will not be presented even if the alarm condition occurs again.
Add	Adds custom trend alarms and sets alarm properties. To delete a custom alarm, select the editing symbol  to enter the Custom Trend Alarm menu and select Delete .

20.5.5 The Other Tab

Section	Menu Item	Default Setting	Description
Alarm Priority	ECG Lead Off	Low	Selects the priority of the ECG lead off alarm.
	SpO2 Sensor Off	Low	Selects the priority of the SpO ₂ sensor off alarm.
	IBP No Sensor	Med	Selects the priority of the IBP No Sensor alarm.
	CMS/eGW Disconnected	Low	Selects the priority of the CMS disconnection alarm.

Section	Menu Item	Default Setting	Description
Alarm Delay	Alarm Delay	12 sec	• 1 sec ~15 sec: for continuously measured parameters, the monitor does not represent the alarm if the alarm condition is resolved within the designated delay time. • Off: an alarm is always presented. The setting of Alarm Delay is not applied to the apnea alarms and the ST alarms.
	ST Alarm Delay	30 sec	The monitor does not present the ST alarm if the alarm condition is resolved within the delay time.
Other	Lethal Arrhy Alarms Off	Disable	Selects whether lethal arrhythmia alarms can be switched off. • Disable: lethal arrhythmia alarms cannot be switched off. • Enable: lethal arrhythmia alarms can be switched off from the ECG menu.
	SPO2 Desat Alarm Off	Disable	Selects whether the SpO₂ Desat alarm can be switched off. • Disable: the SpO₂ Desat alarm cannot be switched off. • Enable: the SpO₂ Desat alarm can be switched off.
	Apnea Alarm Off	Disable	Selects whether the apnea alarm can be switched off. • Disable: the apnea alarm cannot be switched off. • Enable: the apnea alarm can be switched off.
	Arrhy Shield Time	2 min	Alarm light and alarm tone will be disabled for designated period of time when certain arrhythmia alarms are detected. 0: disables this function.
	Intubation Mode Period	2 min	Selects the time for intubation.
	Print on Alarm	Printer	Printer: enables automatic printing via printer when a parameter alarm is triggered. Recorder: enables automatic recording via recorder when a parameter alarm is triggered.
	CMS/eGW Disconnected Alarm	Off	Selects whether an alarm is issued when the monitor is not connected or disconnected from the CMS. Off: the "Offline" alarm is not presented when the monitor is not connected or disconnected from the CMS.
	Notify Alarm Setting Change	Off	Selects whether the monitor gives a prompt when alarm settings, including alarm limits, priorities, and switches, are changed from the CMS.

20.6 The Module Settings

20.6.1 The ECG Tab

Menu Item	Default Setting	Description
ECG Standard	AHA	Selects the ECG standard according to the leadwires you are using.

Menu Item	Default Setting	Description
QTc Formula	Hodges	Selects the QTc formula used to correct the QT interval for heart rate. • Hodges: $QT_c = QT + 1.75 \times (\text{HeartRate} - 60)$ • Bazett: $QT_c = QT \times \left(\frac{\text{HeartRate}}{60} \right)^{\frac{1}{2}}$ • Fridericia: $QT_c = QT \times \left(\frac{\text{HeartRate}}{60} \right)^{\frac{1}{3}}$ • Framingham: $QT_c = QT + 154 \times \left(1 - \frac{60}{\text{HeartRate}} \right)$

20.6.2 The CO2 Tab

Menu Item	Default Setting	Description
Zero Recovery For 30s	On	• On: After the zero calibration is completed, the CO₂ module reacquires the CO₂ readings. During the reacquisition period, "Zero Recovering" is displayed in the CO₂ numeric area. • Off: After the zero calibration is completed, the CO₂ module reacquires the CO₂ readings. During the reacquisition period, "Zero Recovering" is not displayed in the CO₂ numeric area.
Zero	/	Select this button to start zeroing the CO ₂ module.
Gas Temperature	35.0	Select the temperature for the gas in the airway of the mainstream CO ₂ .

20.6.3 The Other Tab

Menu Item	Default Setting	Description
IBP Filter	12.5 Hz	/
PAWP Timeout	15 min	The measurements become outline fonts after a preset time. This avoids older values being misinterpreted as current measurements.
C.O. Timeout	15 min	
NIBP Timeout	15 min	
Outline Font for Suspected Values	Off	Selects whether unreliable HR and SpO ₂ measurements are displayed in outline font. This prevents unreliable measurements from being misinterpreted as normal measurements,

20.7 The Review Settings

20.7.1 The Tabs Tab

Menu Item	Default Setting	Description
Tabular Trends	Selected	Hides the trends you do not need to review if deselected.
Graphic Trends		
Events		
Full Disclosure		
ST		

20.7.2 The Event Tab

Menu Item		Default Setting	Description
Lethal	Lock	Selected	Selects what kind of events will be locked. Locked events will not be deleted.
High		Unselected	
Med			
Low			
Rename Event		On	Selects whether arrhythmia events can be renamed.

20.7.3 The Arrhy Mark Tab

From the **Arrhy Mark** page, you can define whether the compressed ECG waveform segments for arrhythmia events are marked with a specific background color.

20.7.4 The Export Tab

From the **Export** page, select **Export Patient Data**, and then select desired animals from the animal list to export data of selected animals via a USB drive.

20.7.5 The Save Path Tab

From the **Save Path** page, select the path to store review data:

- **Local:** store review data locally in the monitor.
- **USB Drive:** store review data in the U drive users plug into the monitor. When selecting this option, restart the monitor is required in order to make this option effective.

20.8 The Print Settings

20.8.1 The Printer Tab

Menu Item	Default Setting	Description
Connection Type	Printer	Selects you want to output animal reports via the print server or a network printer.
Printer IP Address	0.0.0.0	For printer only.
Paper Size	A4	
Printer Resolution	300 dpi	

Menu Item		Default Setting	Description
Print Server Address		/	For print server only. If the CMS is used as the printer server, set the Port to 6603.
Print Server IP Address		/	
Port		6603	
General Report (for print server only)	Printer	/	Selects the default printer (for paper report only).
	Printer Resolution	/	Selects the resolution for the default printer (for paper report only).
	PDF Resolution	600 dpi	Selects the resolution for the default printer (for PDF report only).
	Print Action	Paper	Selects the media of the reports.
	Color Mode	Color	Select the default printer color.
End Case Report (for print server only)	Printer	/	Selects the default printer (for paper report only).
	Printer Resolution	/	Selects the resolution for the default printer (for paper report only).
	PDF Resolution	600 dpi	Selects the resolution for the default printer (for PDF report only).
	Print Action	Paper	Selects the media of the reports.
	Color Mode	Color	Select the default printer color.
Print on Alarm Report (for print server only)	Printer	/	Selects the default printer (for paper report only).
	Printer Resolution	/	Selects the resolution for the default printer (for paper report only).
	PDF Resolution	600 dpi	Selects the resolution for the default printer (for PDF report only).
	Print Action	Paper	Selects the media of the reports.
	Color Mode	Color	Select the default printer color.
Print Test Page		/	Tests whether the printer works properly.

NOTE

- **General reports refer to the reports other than the end case report and realtime alarm report.**

20.8.2 The Report Layout Tab

Menu Item	Default Setting	Description
Report Layout	/	Selects the contents and location of the animal information included in non-ECG reports. N/A: refers to no information. animal information configured in the Report Layout page is not applied to ECG reports.

20.8.3 The ECG Report Tab

Menu Item	Default Setting	Description
Patient Name	/	Selects the animal information you want to display on ECG reports.
Age		
Gender		
Patient ID	Selected	
Visit Number	Unselected	
Physician		
Department		
Room No		
Bed No		
Owner		

20.8.4 The PDF File Name Tab

Menu Item	Default Setting	Description
PDF File Name	/	Selects the name of PDF files. N/A: refers to no information.

20.8.5 The Other Tab

Menu Item	Default Setting	Description
Second Mark (Printer)	On	Selects whether to show second marks on the report output by the printer.
Arrhy Setting(Recorder)	Off	Selects whether to include arrhythmia thresholds and QRS thresholds in the report output by the recorder.

20.9 The Unit Settings

Menu Item	Default Setting	Description
Length Unit	cm	Selects measurement unit for each parameter.
Weight Unit	kg	
ST Unit	mV	
Hb Unit	g/dl	
CVP Unit	cmH2O	
CO2 Unit	mmHg	
Temp Unit	°C	
Pressure Unit	mmHg	

20.10 The Time Settings

20.10.1 The Time Synchronization Tab

Section	Menu Item	Default Setting	Description
/	Time Zone	UTC- 0 0	Selects the time zone where the monitor belongs.
Nighttime	From	22:00	Selects the night time for heart rate statistics.
	To	06:00	
/	Start NTP Time Sync	Off	On: enables synchronizing the monitor time with the NTP server time.
	Interval	1 hr	Select the time interval for synchronizing the monitor time with the NTP server time.
	Time Server Address	/	The domain name of the time server.
	Time Server	/	The IP address of the time server.
	Network Test	/	Tests whether the NTP server is properly connected.

20.10.2 The Daylight Savings Time Tab

Section	Default Setting	Description
Auto Daylight Savings Time	Off	On: auto starts the daylight saving time.
Daylight Savings Time Start	/	
Daylight Savings Time End	/	

20.11 The Other Settings

Menu Item		Default Setting	Description
Barometric Pressure		760 mmHg	For the mainstream CO2 module, enter the value of barometric pressure to which the animal monitor is exposed to. Be sure to set the barometric pressure properly. Improper settings will result in erroneous measurements.
Notch Frequency		50 Hz	Selects notch filter frequency according to the power line frequency of your country.
Mouse Sensitivity		5	/
Clear CMS IP at startup		Off	/
Parameter Output Setup	Baud Rate	Off	Reserved for future use.
	Parity Mode	None	
	Data Bits	8	
	Stop Bits	1	
SpO2 Tone		Mode 1	Selects the SpO ₂ tone mode. The monitor adjusts the QRS tone (pitch tone) according to the SpO ₂ values. The same SpO ₂ tone mode shall be used for the same monitors in a single area.
Language		/	/

Menu Item	Default Setting	Description
Parameters On/Off Config Influenced	On	Selects whether the settings of parameter switches are influenced by configuration
Parameters On/Off Protected	Off	Selects whether setting parameter switches is password protected.
Parameters On/Off	/	Selects what parameters can be monitored.
Browse System Log	/	Selects this button to enter the System Log page, and then selects the log classifications you want to view. Selecting Search to view the selected logs. To view logs of certain date and time, select Jump To and define the date and time.
Export System Log	/	Selects this button to export the system log to the USB drive.
Manual Event Edit	OR: Off Other departments: On	Selects whether selecting and editing the name of a manual event is allowed.

20.12 The Authorization Setup Settings

Section	Menu Item	Default Setting	Description
/	Automatic Logout Time	20 sec	Selects timeout period of the MLDAP password for accessing the Maintenance menu, alarm settings and arrhythmia settings. If there is no operation after the specified timeout period is reached, you need to re-input the password.
Maintenance	User Maintenance	Local Password	Selects the password for accessing the monitor's Maintenance menu. • Local Password: the monitor's password for accessing the Maintenance menu is required. • User Password: the user name and password saved in the MLDAP server are required.
	Modify Local Password	/	Changes the monitor's password for accessing the Maintenance menu.

Section	Menu Item	Default Setting	Description
Clinical Setting	Alarm Setup	No Password	Selects the password for changing alarm settings. • No Password: changing alarm settings is not password protected. • Local Password: changing alarm switch, alarm limit, and alarm priority is password protected. The monitor's clinical password is required. • User Password: changing alarm switch, alarm limit, and alarm priority is password protected. The user name and password saved in the MLDAP server are required.
	Arrhythmia	No Password	Selects the password for changing arrhythmia settings. • No Password: changing arrhythmia settings is not password protected. • Local Password: changing arrhythmia switch, alarm priority, and arrhythmia threshold is password protected. The monitor's clinical password is required. • User Password: changing arrhythmia switch, alarm priority, and arrhythmia threshold is password protected. The user name and password saved in the MLDAP server are required.
	View Discharged Patients	No Password	Selects the password for viewing discharged animals. • No Password: viewing discharged animals is not password protected. • User Password: viewing discharged animals is password protected. The user name and password saved in the MLDAP server are required.
	Viewing Patient Review Data	No Password	Selects the password for viewing discharged animals. • No Password: reviewing animal data is not password protected. • Local Password: reviewing animal data is password protected. The monitor's clinic password is required.
	Modify Local Password	/	Changes the monitor's clinical password.

20.13 The Version Settings

Tab	Default Setting	Description
Version	/	Displays system software version, module hardware and software version, and firmware version.

20.14 The Battery Information Settings

Tab	Default Setting	Description
Battery	/	Displays battery information.

20.15 The Scanner Settings

20.15.1 The 2D Barcode Tab

This tab is applicable to Mindray Animal Medical custom 2D barcode reader only.

Tab	Default Setting	Description
2D Barcode	/	Establishes the relationship between the monitor data and barcode data for selectable animal demographics.

20.15.2 The 1D Barcode Tab

Menu Item	Default Setting	Description
Content Fill to	Patient ID	/

20.15.3 The Scanner Information Tab

Menu Item	Default Setting	Description
Scanner Type	2D Scanner	• 1D Scanner: select this option when you are using a 1D scanner or a 2D scanner other than the Mindray Animal Medical custom 2D scanner. • 2D Scanner: select this option when you are using the Mindray Animal Medical custom scanner.
Data Encoding Type	UTF8	When you set Scanner Type to 2D Scanner , default settings are applied to Data Encoding Type and Data Parse Mode . You do not need to change these settings.
Data Parse Mode	Local	

20.15.4 The Identify Scanner Tab

This tab is applicable to non-Mindray Animal Medical custom 2D barcode reader.

Tab	Default Setting	Description
Identify Scanner	/	When you are using barcode readers unspecified, you should select the barcode reader from the USB device list, so that the monitor can identify the barcode reader. From the USB device list, select the barcode reader you are using.

20.15.5 The Field Tab

This tab is applicable to Mindray Animal Medical custom 2D barcode reader.

Menu Item	Default Setting	Description
Visit Number	Unselected	Selects desired animal information to be output by the barcode reader.
Patient Name	Selected	
Species		
Room No	Unselected	
Bed No		

Menu Item	Default Setting	Description
Gender	Selected	
Age	Unselected	
Breed		
Custom Field 1 - Custom Field 3		

20.16 The Network Setup Settings

20.16.1 The Network Type Tab

Menu Item	Default Setting	Description
Monitor	Auto	Selects what kind of network your monitor will use. Auto: the monitor can automatically identify your network type.

20.16.2 The LAN1 IP Tab

Menu Item	Default Setting	Description
Obtain IP Address Automatically	Selected	Automatically gets the IP address.
Use the Following Address	Unselected	IP Address, Subnet Mask, and Gateway are required.
IP Address	0.0.0.0	
Subnet Mask	0.0.0.0	
Gateway	0.0.0.0	
Obtain DNS address automatically	Selected	Automatically gets the DNS address
Using the Following DNS Address	Unselected	IP addresses of Preferred DNS Server and Alternate DNS Server are required.
Preferred DNS Server	0.0.0.0	
Alternate DNS Server	0.0.0.0	

20.16.3 The WLAN Tab

Menu Item		Default Setting	Description
Add WLAN		/	Add wireless network and set the network in the pop-up menu.
WLAN	Name	/	Input the name of the wireless network.
	SSID	/	/
	Security	WEP OFF	Selects the security method.
	Password	/	Input the password for entering the wireless network.

Menu Item		Default Setting	Description
WLAN IP	Obtain IP Address Automatically	On	Selects whether to enable the function of automatically getting the IP address.
	Use the Following Address	Off	Selects whether inputting the IP Address , Subnet Mask , and Gateway is required.
	IP Address	0.0.0.0	
	Subnet Mask	0.0.0.0	
	Gateway	0.0.0.0	
	Obtain DNS address automatically	On	Selects whether to enable the function of automatically getting the DNS address.
	Using the Following DNS Address	Off	Selects whether inputting the IP address of Preferred DNS Server and Alternate DNS Server is required.
	Preferred DNS Server	0.0.0.0	
	Alternate DNS Server	0.0.0.0	
WLAN Setup	WLAN Band	Auto	Auto: automatically identifies the WLAN band.
	2.4G Channel	All	Selects the 2.4G channels.
	5G Channel	All	Selects the 5G channels.
Network Test		/	Tests whether the wireless network is properly connected.
Certificate Management	Local	/	Delete: delete the selected certifications.
	USB Drive	/	Select certifications you want to import from the USB memory, and then select Import: import the desired certifications from the USB memory.

20.16.4 The Central Station Setup Tab

You can add up to 10 CMSs for the monitor.

Menu Item	Default Setting	Description
Select CMS	On	Selects whether to enable the CMS selection function for your monitor.
Add Local Central Station	/	Inputs the name, and server address of the local CMS.
Add Cloud Central Station	/	Inputs the name, server address, user name and password of the CMS of the cloud CMS.

20.16.5 The Device Discover Tab

Multicast helps device discovery between monitors and between monitors and CMS. Devices in the same multicast group can be mutually discovered.

Menu Item	Default Setting	Description
Multicast TTL	1	/
Multicast Address	225.0.0.8	
Master Server Address	/	/
Master Server IP Address	0.0.0.0	
Connected Status	Disconnected	

Menu Item	Default Setting	Description
Network Test	/	Tests whether the master server is properly connected.

20.16.6 The QoS Tab

Menu Item	Default Setting	Description
QoS Level For Realtime Monitoring	0	Selects the service quality of network connection for realtime monitoring, for example parameter measurements and waveforms, alarms, and so on
QoS Level For Others	0	Selects the service quality of network connection for non-realtime monitoring, for example history data, printing, and as on.

20.16.7 The HL7 Configuration Tab

You can send the realtime data, waveforms, and alarms from the monitor to the hospital servers via HL7 protocol. This page also display the server connection status. Licenses are required for sending data, waveforms, and alarms via HL7.

Section	Menu Item	Default Setting	Description
Data + Waveforms	Server Address	/	Inputs the name or IP address for the server receiving the realtime data and waveform.
	Destination IP	0.0.0.0	
	Port	0	
	Send Data	Off	/
	Data Interval	30 sec	
	Send Waveforms	Off	
	Connection Status	Disconnected	
Alarms	Server Address	/	Inputs the name or IP address for the server receiving the alarm data.
	Destination IP	0.0.0.0	
	Port	0	/
	Send Alarms	Off	
	Connection Status	Disconnected	
Compatibility	HL7 Protocol Version	HL7 Protocol Version	Selects the version of the HL7 protocol.

20.16.8 The Information Security Tab

Menu Item	Default Setting	Description
Encryption Connection Type	Only Private Encryption	• Only Private Encryption: Mindray Animal Medical private encryption is used to encrypt the transmitted data. You cannot connect devices supporting SSL (secure sockets layer) encryption. • SSL Encryption Priority: for devices supporting SSL encryption, SSL encryption is used when connecting the devices. For devices not supporting SSL encryption, private encryption is used when connecting the devices.

Menu Item	Default Setting	Description
Broadcast Patient Demographics	On	• On: when viewing other animals, device location and animal information of remote devices are displayed in the remote device list. • Off: animal information does not display in the remote device list.

20.16.9 The MLDAP Tab

Menu Item	Default Setting	Description
Server Address	/	Inputs the name or IP address for the MLDAP server.
IP Address	0.0.0.0	
Port	0	/
Network Test	/	Tests whether the monitor is properly connected with the MLDAP server.

21 Care and Cleaning

21.1 Care and Cleaning Introduction

In this chapter we only describe cleaning and disinfection of the monitor and certain accessories. For the cleaning and disinfection of other reusable accessories, refer to their instructions for use.

21.2 Care and Cleaning Safety Information

WARNING

- Use only cleaners, disinfectants and methods specified in this chapter. Using unapproved substances or methods may damage the equipment and void the warranty.
 - Do not mix disinfecting solutions, as hazardous gases may result.
 - Mindray Animal Medical is not liable for the efficacy of the specified cleaners, disinfectants, or methods as a means for controlling infection. Refer to your hospital for infection controlling.
 - Be sure to turn off the system and disconnect all power cables from the outlets before cleaning the equipment.
 - The responsible hospital or institution shall carry out all cleaning and disinfection procedures specified in this chapter.
-

CAUTION

- Never immerse any part of the equipment or accessories in liquids or allow liquid to enter the interior.
 - Any contact of cleaners or disinfectants with connectors or metal parts may cause corrosion.
 - Do not pour or spray any liquid directly on the equipment or accessories or permit fluid to seep into connections or openings.
 - If you spill liquid on the equipment or accessories, disconnect the power supply, dry the equipment, and contact the Customer Service Department or your local distributor.
 - Never use abrasive materials (such as steel wool or silver polish), or erosive cleaners (such as acetone or acetone-based cleaners).
 - Dilute and use the cleaners or disinfectants according to the manufacturer's instructions.
 - Check the equipment after cleaning and disinfecting. If there is any sign of damage, remove it from use.
-

21.3 Cleaning the Monitor

Clean your equipment on a regular basis. Before cleaning the equipment, consult your hospital's regulations for cleaning the equipment.

To clean the equipment, follow this procedure:

1. Dampen a soft lint-free cloth with water or ethanol (70%).
2. Wring excess liquid from the cloth.
3. Wipe the display screen of the monitor.
4. Wipe the external surface of the monitor with the damp cloth, avoiding the connectors and metal parts.
5. Dry the surface with a clean cloth. Allow the equipment air dry in a ventilated and cool place.

CAUTION

- During the cleaning procedure, disable the touch operation by switching off the monitor or locking the touchscreen.
 - Any contact of cleaners or disinfectants with connectors or metal parts may cause corrosion.
-

21.4 Disinfecting the Monitor

Disinfect the equipment as required in your hospital's servicing schedule. Cleaning the equipment before disinfecting is recommended. Always dilute and use disinfectants according to the manufacturer's instructions. The following table lists approved disinfectants:

Product Name	Product Type	Manufacturer
PDI Super Sani-Cloth® Germicidal Disposable Wipe	Wipes	PDI Inc.
Ethanol, 70%	Liquid	/
Isopropanol, 70%	Liquid	/
Sodium hypochlorite bleach, 0.5%	Liquid	/
Hydrogen peroxide, 3%	Liquid	/
Rely+On™ Virkon® High Level surface Disinfectant, 1%	Powder	Antec International Ltd
1-Propanol, 50%	Liquid	/

21.5 Cleaning and Disinfecting the Accessories

To clean and disinfect the following accessories, using cleansers, disinfectants, and methods described in this manual:

- NIBP air hose
- SpO₂ cable

For other accessories, you should consult the instructions delivered with the accessories.

CAUTION

- Fluids entering the NIBP air hose can damage the equipment. When cleaning or disinfecting the NIBP air hose, prevent liquid from entering the hose.
 - Periodically inspect the NIBP air hose and connector for signs of wear or deterioration after cleaning or disinfecting the NIBP air hose. Replace the NIBP air hose if you detect a leak. Dispose of damaged NIBP air hose according to local laws for disposal of hospital waste.
 - Never immerse or soak the accessories in any liquid.
 - Never clean or disinfect the connectors and metal parts.
 - Use only Mindray Animal Medical approved cleaners and disinfectants and methods listed in this section to clean or disinfect the accessories. Warranty does not cover damage caused by unapproved substances or methods.
 - To avoid long term damage, the accessories should be disinfected only when necessary as determined by your hospital's policy.
-

21.5.1 Cleaning the Accessories

You should clean the accessories on a regular basis. Before cleaning the accessories, consult your hospital's regulations for cleaning the accessories.

To clean the accessories, follow this procedure:

1. Clean the accessories with a soft cloth moistened with water or ethanol (70%).

2. Wipe off all the cleaner residue with a dry cloth.
3. Allow the accessories to air dry.

21.5.2 Disinfecting the Accessories

We recommend that the accessories should be disinfected only when necessary as determined by your hospital's policy. Cleaning the accessories before disinfecting is recommended.

21.5.2.1 Disinfectants for the NIBP Air Hose

The following table lists approved disinfectants for the NIBP air hose:

Product Name	Product Type	Manufacturer
Glutaraldehyde, 2%	Liquid	/
Ethanol, 70%	Liquid	/
Isopropanol, 70%	Liquid	/

21.5.2.2 Disinfectants for the SpO₂ Cable

The following table lists approved disinfectants for the SpO₂ cables:

Product Name	Product Type	Manufacturer
CIDEX® OPA	Liquid	Gilag GmbH International Advanced Sterilization products
Clorox Dispatch® Hospital Cleaner Disinfectant Towels with Bleach	Wipes	Clorox professional products company
Clorox Healthcare® Bleach Germicidal Wipes	Wipes	Clorox professional products company
Clorox Healthcare® Hydrogen Peroxide Cleaner Disinfectant Wipes	Wipes	Clorox professional products company
Diversey Oxivir® TB Wipes	Wipes	Diversey Inc
PDI Super Sani-Cloth® Germicidal Disposable Wipe	Wipes	PDI Inc.
VIRAGUARD® Hospital Surface Disinfectant Towelette	Wipes	VERIDIEN corporation
Virex® TB	Liquid, spray	Diversey Inc
Glutaraldehyde, 2%	Liquid	/
Ethanol, 70%	Liquid	/
Isopropanol, 70%	Liquid	/
Sodium hypochlorite bleach, 0.5%	Liquid	/
Hydrogen peroxide, 3%	Liquid	/
Rely+On™ Virkon® High Level surface Disinfectant, 1%	Powder	Antec International Ltd
1-Propanol, 50%	Liquid	/

21.6 Sterilization

Do not sterilize the monitor, accessories, or supplies unless otherwise specified in the instructions for use delivered with the accessories and supplies.

21.7 Cleaning the Thermal Print Head

Dirty print head deteriorates printing quality. Check the printout to ensure the printing is legible and dark. Light printing may indicate a dirty print head.

To clean the thermal print head, follow this procedure:

1. Take measures against the static electricity, such as the wrist strap.
2. Remove the recorder module from the module rack.
3. Open the recorder door and remove the recording paper.
4. Gently wipe the print head with cotton swabs dampened with ethanol to remove the dust and foreign particles.
5. Wipe off excess moisture with dry cotton swabs.
6. Allow the print head air dry.
7. Reload the recording paper and close the recorder door.

CAUTION

- **Do not use anything that may destroy the thermal element.**
 - **Do not add unnecessary force to the thermal head.**
 - **The thermal print head gets hot when recording. Do not clean the print head immediately after recording.**
-

21.8 Impact of Improper Cleaning

Using cleaners other than those recommended may have the following impact:

- Product discoloration
- Metal part corrosion
- Brittle and breaking wires, connectors, and equipment housing
- Reduced cable and leadwire life
- Overall system performance degradation
- Equipment malfunction or failure

22 Maintenance

22.1 Maintenance Introduction

Regular maintenance is essential to ensure that the monitor functions properly. This chapter contains information on periodic testing and maintenance.

22.2 Maintenance Safety Information

WARNING

- Follow the maintenance and testing schedule or local regulations to perform testing and maintenance. Not implementing the maintenance schedule may cause monitor failure and possible health hazards.
 - No modification of this monitor is allowed.
 - This monitor contains no user serviceable parts.
 - The safety checks or maintenance involving any disassembly of the monitor should be performed by professional service personnel. Otherwise, undue monitor failure and possible health hazards could result.
 - Do not open batteries, heat batteries to above 60 °C, incinerate batteries, or short the battery terminals. Batteries may ignite, explode, leak or heat up, causing personal injury.
 - The service personnel must be properly qualified and thoroughly familiar with the operation of the monitor.
-

CAUTION

- The monitor and its accessories shall not be served or maintained while in use with an animal.
 - If a problem occurs to the monitor, contact the Customer Service Department or your local distributor.
 - Use and store the monitor within the specified temperature, humidity, and elevation ranges.
 - When disposing of the packaging material, be sure to observe the applicable waste control regulations and keep it out of children's reach.
 - At the end of its service life, the monitor, as well as its accessories, must be disposed of in compliance with the guidelines regulating the disposal of such products. If you have any questions concerning disposal of the monitor, please contact the Customer Service Department or your local distributor.
-

NOTE

- If needed, contact the manufacture for component part lists, descriptions, calibration instructions, or other information concerning the repair of the equipment.
-

22.3 Maintenance and Testing Schedule

Follow the maintenance and testing schedule or local regulations to perform testing and maintenance. Make sure to clean and disinfect the equipment before taking any tests and maintenance

The following table lists the maintenance and testing schedule:

Test/Maintenance Item		Recommended Frequency
Performance Tests		
Visual inspection		Every day, before first use.
Measurement module performance test and calibration		1. If you suspect that the measurement values are incorrect. 2. Follow any repairs or replacement of relevant module. 3. Once a year for the CO ₂ test. 4. Once every two years for other parameter module performance tests.
Analog output test		If you suspect that the analog output function does not work properly.
Defibrillation synchronization test		If you suspect that the defibrillation synchronization function does not work properly.
Electrical Safety Tests		
Electrical safety tests		Once every two years.
Other Tests		
Power-on test		Before use.
Recorder check		1. When the recorder is used for the first time. 2. Follow any repair or replacement of the recorder.
Network printer tests		1. When first installed. 2. Follow any repair or replacement of the printer.
Battery check	Functionality test	1. When first installed. 2. When battery is replaced.
	Performance test	Every three months or if the battery runtime reduced significantly.

22.4 Checking Version Information

You may be asked for information on monitor and module version.

To view system software version information, select the **Main Menu** hard key or quick key → from the **System** column select **Version**.

You can check system software version, module hardware and software version, and firmware version.

22.5 Testing Methods and Procedures

Except the following maintenance tasks, all other test and maintenance tasks should be performed by Mindray Animal Medical-qualified service personnel only.

- Regular check, including visual inspection and power-on test
- Printer and recorder tests
- Battery check

If your equipment needs a safety test and performance test, contact the Customer Service Department or your local distributor.

22.5.1 Performing Visual Inspection

Visually inspect the equipment before its first use every day. If you find any signs of damage, remove the equipment from use and contact the Customer Service Department or your local distributor.

Verify that the equipment meets the following requirements:

- Environment and power supply specifications are met.
- The monitor housing and display screen are free from cracks or other damages
- The power cord is not damaged and the insulation is in good condition.
- Connectors, plugs, and cables are not damaged and kinked.
- Power cord and animal cables are securely connected with the equipment and modules.

22.5.2 Performing Power-on Test

The equipment automatically performs a selftest at startup. Check the following items for the power-on test:

- The equipment powers on properly.
- The alarm system works properly.
- The equipment displays properly.

22.5.3 Testing the Recorder

To test the recorder, follow this procedure:

1. Start a recording task to print waveforms and reports.
2. Check that the recorder functions correctly.
3. Check that the printout is clear without missing dots.

22.5.4 Testing the Network Printer

To check the printer, follow this procedure:

1. Start a printing task to print waveforms and reports.
2. Check that the printer is properly connected and functions correctly.
3. Check that the printout is clear without missing dots.

22.5.5 Checking the Battery

For information on battery check, see 3.3.2.2 *Checking Battery Performance*.

22.6 Disposing of the Equipment

Dispose of the monitor and its accessories when its service life is reached. Follow local regulations regarding the disposal of such product.

WARNING

- **Unless otherwise specified, dispose of parts and accessories in accordance with local regulations regarding disposal of hospital waste.**
-
-

23 Accessories

The accessories listed in this chapter comply with the requirements of IEC 60601-1-2 when in use with the monitor.

WARNING

- **Use accessories specified in this chapter. Using other accessories may cause damage to the monitor or not meet the claimed specifications.**
- **Single use accessories are not designed to be reused. Reuse may cause a risk of contamination and affect the measurement accuracy.**

CAUTION

- **The accessories may not meet the performance specifications if stored or used outside the specified temperature and humidity ranges. If accessory performance is degraded due to aging or environmental conditions, contact the Customer Service Department or your local distributor.**
- **Check the accessories and their packages for any sign of damage. Do not use them if any damage is detected.**
- **Use the accessories before the expiry date if their expiry date is indicated.**
- **The disposable accessories shall be disposed of according to hospital's regulations.**

23.1 ECG Accessories

Name	Model	Description	Type
Trunk cable	EV6201	12Pin 3/5-Lead ECG Host Cable (Vet)	Reusable
Eletrode	EB6903	Alligator Clip,Vet	Disposable
	H124SG	ECG Eletrode	Reusable
ECG leadwires	EL6501B	5-Lead Leadset, AHA, Snap, Vet	Reusable
	EL6301B	3-Lead Leadset, AHA, Snap, Vet	
	EL6502B	5-Lead Leadset, IEC, Snap, Vet	
	EL6303A	3-Lead Leadset, AHA, Clip, Long, Vet	
	EL6504A	5-Lead Leadset, IEC, Clip, Long, Vet	
	EL6302B	3-Lead Leadset, IEC, Snap, Vet	
	EL6304A	3-Lead Leadset, IEC, Clip, Long, Vet	
	EL6501A	5-Lead Leadset, AHA, Clip, Vet	
	EL6301A	3-Lead Leadset, AHA, Clip, Vet	
	EL6503A	5-Lead Leadset, AHA, Clip, Long, Vet	
	EL6502A	5-Lead Leadset, IEC, Clip, Vet	
	EL6302A	3-Lead Leadset, IEC, Clip, Vet	

Name	Model	Description	Type
Esophageal Lead	ODM-W0013B	E-Probe (Large, for BW>13kg animal)	Reusable
	ODM-W0013A	E-Probe (Small, for BW<13kg animal)	

23.2 SpO₂ Accessories

Wavelength emitted by the sensors is between 600 nm and 1000 nm. The maximum photic output consumption of the sensor is less than 18 mW.

The information about the wavelength range and maximum photic output consumption can be especially useful to clinicians, for example, when photodynamic therapy is performed.

Name	Model	Description	Type	Remarks
SpO ₂ extension cable	/	7Pin SpO ₂ Extension Cable	Reusable	Mindray
SpO ₂ sensor	551B	Veterinary SpO ₂ Sensor (Reusable, 2-Clips)		Mindray

23.3 Temp Accessories

Name	Model	Description	Type
Temperature probe	MR401B	Reusable temperature probe, esophageal (for large animal)	Reusable
	MR402B	Reusable temperature probe, esophageal (for small animal)	

23.4 NIBP Accessories

Name	Model	Description	Type
NIBP hoses	CMA92 Vet	Tube for NIBP Cuff, Vet, Self locking	Reusable
NIBP hoses	CMA91 Vet	Tube for NIBP Cuff, Vet	
NIBP cuff	CMA01 Vet	NIBP Cuff 1#, Vet (CMA01 Vet, 3.1-5.7cm)	Disposable
	CMA02 Vet	NIBP Cuff 2#, Vet (CMA02 Vet, 4.3-8.0 cm)	
	CMA03 Vet	NIBP Cuff 3#, Vet (CMA03 Vet, 5.8-10.9 cm)	
	CMA04 Vet	NIBP Cuff 4#, Vet (CMA04 Vet, 7.1-13.1cm)	
	CMA05 Vet	NIBP Cuff 5#, Vet (CMA05 Vet, 8-15cm)	
NIBP cuff	CMA11 Vet	NIBP Cuff 1#, Vet (CMA11 Vet, 15-20 cm)	Reusable
	CMA12 Vet	NIBP Cuff 2#, Vet (CMA12 Vet, 19-25 cm)	
	CMA13 Vet	NIBP Cuff 3#, Vet (CMA13 Vet, 24-32 cm)	
	CMA14 Vet	NIBP Cuff 4#, Vet (CMA14 Vet, 32-42 cm)	
	CMA15 Vet	NIBP Cuff 5#, Vet (CMA15 Vet, 42-50 cm)	

23.5 IBP Accessories

Name	Model	Description	Type
IBP cable	IM2202	12-pin IBP cable, Argon	Reusable
	IM2201	12 Pin IBP cable, ICU Medical	
IBP transducer	DT-4812	IBP transducer, disposable, Argon	Disposable
	42584	IBP transducer, disposable, ICU Medical	
Transducer bracket	682275	Transducer/Manifold Mount, Argon	Reusable
	42602	Steady Rest for IBP Transducer and Clamp, ICU Medical	
	42394	Steady Rest for IBP Transducer and Clamp, ICU Medical	

23.6 C.O. Accessories

Name	Model	Description	Type
C.O. cable	CO7702	12-pin C.O. cable	Reusable

23.7 CO₂ Accessories

23.7.1 Sidestream CO₂ Accessories

Name	Model	Description	Type
water trap	/	water trap, DRYLINE II, reusable (for large animal)	Reusable
	/	water trap, DRYLINE II, reusable (for small animal)	
Airway sampling line	/	Airway sampling line, disposable (for large animal)	Disposable
	/	Airway sampling line, disposable (for small animal)	
Airway adapter	/	Airway adapter, straight, large, disposable	
	/	Airway adapter, straight, small, disposable	
	/	Airway adapter, elbow, large, disposable	
	/	Low dead space adapter, 2.0-3.5mm, Vet	

23.7.2 Mainstream CO₂ Accessories

Name	Model	Description	Type
Mainstream CO ₂ sensor	GA3701	Mindray Mainstream CO ₂ sensor	Reusable
Airway adapter	GA3211	Reusable MainCO ₂ Adapter, Large, Vet	
	GA3212	Reusable MainCO ₂ Adapter, Small, Vet	

23.8 Other Accessories

No.	Description
1.	Power cord, 250 V, 10 A, 3 m, Brazil
2.	Power cord, 250 V, 16 A, 3 m, South Africa
3.	Power cord, 10 A, 1.5 m, Australia standard
4.	Power cord, 3 m, India
5.	Power cord, 1.8 m, Switzerland
6.	Power cord, 10 A, 250 V, 1.6 m, China
7.	Power cord, USA
8.	Power cord, UK
9.	Power cord, Europe
10.	Thermal Paper (50mm*20m)
11.	Lithium-ion battery, 10.8 V, 2600 mAh, LI13S001G
12.	Lithium-ion battery, 10.95 V, 5200 mAh, LI23S003H

A Product Specifications

A.1 Monitor Safety Specifications

The monitor is classified, according to IEC 60601-1:

Degree of protection against electrical shock	Type CF defibrillation proof for ECG, Resp, SpO ₂ , NIBP, Temp, IBP, C.O. Type BF defibrillation proof for CO ₂
Type of protection against electrical shock	Class I
Degree of protection against harmful ingress of water	main unit: IPX1(protected against harmful effects of vertically falling water drops)
Degree of safety of application in the presence of flammable anesthetic mixture with air or with oxygen or nitrous oxide	The equipment is not suitable for use in the presence of a flammable anesthetic mixture with air or with oxygen or nitrous oxide
Mode of operation	Continuous

A.2 Environmental Specifications

WARNING

- The monitor may not meet the performance specifications if stored or used outside the specified temperature and humidity ranges. If the performance of the equipment is degraded due to aging or environmental conditions, contact the Customer Service Department or your local distributor.
- When the monitor and related products have differing environmental specifications, the effective range for the combined products is that range which is common to the specifications for all products.

NOTE

- The environmental specifications of unspecified parameter modules are the same as those of the main unit.

Main Unit			
Item	Temperature	Relative Humidity (noncondensing)	Barometric
Operating Condition	0°C to 40 °C	15% to 95%	427.5 to 805.5 mmHg (57 to 107.4 kPa)
Storage Condition	-20°C to 60°C	10% to 95%	120 to 805.5 mmHg (16 to 107.4 kPa)
Sidestream CO ₂ Module			
Item	Temperature	Relative humidity (noncondensing)	Barometric
Operating Condition	5°C to 40 °C	15% to 95%	430 to 790 mmHg (57.3 to 105.3 kPa)
Storage Condition	-20°C to 60°C	10% to 95%	430 to 790 mmHg (57.3 to 105.3 kPa)

Mainstream CO ₂ Module			
Item	Temperature	Relative humidity (noncondensing)	Barometric
Operating Condition	0°C to 40°C	10% to 95%	400 to 805.5 mmHg (53.3 to 107.4 kPa)
Storage Condition	-20°C to 60°C	10% to 95%	400 to 805.5 mmHg (53.3 to 107.4 kPa)

A.3 Power Supply Specifications

A.3.1 External Power Supply Specifications

AC Power	
Input voltage	100 to 240 VAC
Input current	2.0 to 0.9 A
Frequency	50/60 Hz

A.3.2 Battery Specifications

Battery LI13S001G	Type	Rechargeable lithium-ion battery
	Voltage	10.8V
	Capacity	2600 mAh
Battery LI23S003H	Type	Rechargeable lithium-ion battery
	Voltage	10.95V
	Capacity	5200 mAh
Run time	Battery LI13S001G: ≥ 4.5 hours Battery LI23S003H: ≥ 10 hours when the monitor is powered by a new fully-charged battery at 25 °C±5 °C with typical configuration (3/5-lead ECG, Resp, SpO ₂ , Temp, auto NIBP measurements at an interval of 15 minutes, and screen brightness set to 1). Shutdown delay: at least 5 minutes after the low battery alarm first occurs.	
Charge time	Battery LI13S001G	When the monitor is off: • No more than 3 hours to 90% • No more than 4 hours to 100% When the monitor is on: • No more than 5.5 hours to 90% • No more than 6 hours to 100%
	Battery LI23S003H	When the monitor is off: • No more than 7 hours to 90% • No more than 8 hours to 100% When the monitor is on: • No more than 11 hours to 90% • No more than 12 hours to 100%

A.4 Physical Specifications

W × H × D (mm)	Maximum Weight (kg)	Remark
≤350 × 250 × 180	4	Standard configuration, standard battery, without accessories, recorder and other modules.

A.5 Hardware Specifications

A.5.1 Display Specifications

Screen type	Color touchscreen
Screen Size	12.1 inches
Resolution	1280 x 800 pixels

A.5.2 Recorder Specifications

Method	Thermal dot array
Horizontal resolution	16 dots/mm (25 mm/s paper speed)
Vertical resolution	8 dots/mm
Paper width	50 mm
Paper speed	25 mm/s, 50 mm/s Accuracy: ±5%
Number of waveform channels	A maximum of 3

A.5.3 LEDs

Alarm lamp	1 or 2 (two color-coded: red, yellow)
Power-on LED	1 (green)
AC power LED	1 (green)
Battery LED	1 (green)

A.5.4 Audio Indicator

Speaker	Give alarm tones (45 to 85 dB), reminder tones, key tones, QRS tones; support PITCH TONE and multi-level tone modulation; alarm tones comply with IEC 60601-1-8.
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A.5.5 Monitor Interface Specifications

AC power input	1
Network connector	1, standard RJ45 connectors, 100 Base-TX, IEEE 802.3
USB connector	2, USB 2.0
Multifunctional connector	1
Video output connector	1, 15-pin D-sub

Equipotential grounding terminal	1
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A.5.6 Signal Outputs Specifications

Auxiliary Output	
Standard	Meets the requirements of IEC 60601-1 for short-circuit protection and leakage current
ECG Analog Output	
Bandwidth (-3dB; reference frequency: 10Hz)	Diagnostic mode: 0.05 to 150 Hz Monitor mode: 0.5 to 40 Hz Surgical mode: 1 to 20 Hz ST mode: 0.05 to 40 Hz Emphasis mode: 2 to 18 Hz Customize mode: available high-pass filter frequencies are 0.01Hz, 0.05Hz, 0.15Hz, 0.25Hz, 0.32Hz, 0.5Hz, 0.67Hz; available low-pass filter frequencies are 25Hz, 35Hz, 45Hz, 75Hz, 100Hz, 150Hz.
Maximum QRS delay	25 ms (in diagnostic mode, and non-paced)
Gain (reference frequency 10Hz)	1V/mV ($\pm 5\%$)
Pace enhancement	Signal amplitude: $V_{oh} \geq 2.5V$ Pulse width: $10ms \pm 5\%$ Signal rising and falling time: $\leq 100\mu s$
Defib Sync Pulse	
Output impedance	$\leq 100 \text{ ohm}$
Maximum time delay	35 ms (R-wave peak to leading edge of pulse)
Amplitude	High level: 3.5 to 5 V, $\pm 5\%$, providing a maximum of 10 mA output current; Low level: $< 0.5 \text{ V}$, receiving a maximum of 5 mA input current.
Pulse width	$100 \text{ ms} \pm 10\%$
maximum rising and falling time	1 ms
Alarm Output	
Alarm delay time from the monitor to remote equipment	The alarm delay time from the monitor to remote equipment is ≤ 2 seconds, measured at the monitor signal output connector.
Alarm signal sound pressure level range	45 db(A) to 85 db(A) within a range of one meter

A.6 Data Storage

Trends	Internal card: - Up to 4 hours of trend data with the resolution no less than 5 seconds - Up to 120 hours of trend data with the resolution no less than 1 minute - Up to 1200 hours of trend data with the resolution no less than 10 minutes. External card: - Up to 240 hours of trend data with the resolution no less than 1 minute - Up to 2400 hours' trend data with the resolution no less than 10 minutes.
Events	- Internal card: 1000 events - External card: 5000 events 128 arrhythmia events
NIBP measurements	- Internal card: 1600 sets. - External card: 5000 sets.

Full-disclosure waveforms	Up to 120 hours for one waveform. The specific storage time depends on the waveforms stored and the number of stored waveforms.
ST view	At least 120 hours of ST segment waveforms. One group of ST segment waveforms is stored every 5 minutes.

A.7 Wi-Fi Specifications

A.7.1 Wi-Fi Technical Specifications

Protocol	IEEE 802.11a/b/g/n/ac
Modulation mode	BPSK, QPSK, 16QAM, 64QAM, 256QAM
Operating frequency	2412 MHz to 2472 MHz 5180 MHz to 5320 MHz, 5500 MHz to 5700 MHz, 5745 MHz to 5825 MHz WARNIGN: SX-SDMAC-2832S+ module supports the DFS channels. When using the DFS channels, Wi-Fi performance stability and roaming time can be undermined due to avoiding interfering with Radar systems. DFS channels are disabled by default and not recommended. The operator should comprehensively assess the risk before using the DFS channels.
Wireless data rate	IEEE 802.11a: 6 Mbps to 54 Mbps IEEE 802.11b: 1 Mbps to 11 Mbps IEEE 802.11g: 6 Mbps to 54 Mbps IEEE 802.11n: MCS0 - MCS7 IEEE 802.11ac: MCS0 - MCS8
Output power	<20 dBm (CE requirements, detection mode: RMS) <30 dBm (FCC requirements, detection mode: peak power)
Operating mode	As station, access AP for data transmission
Data security	Standards: WPA-PSK, WPA2-PSK, WPA-Enterprise, WPA2-Enterprise EAP method: EAP-FAST, EAP-TLS, EAP-TTLS, PEAP-GTC, PEAP-MSCHAPv2, PEAP-TLS, LEAP Encryption: TKIP, AES

A.7.2 Wi-Fi Performance Specifications

WARNING

- Do perform all network functions of data communication within an enclosed network.

A.7.2.1 System Capacity and Resistance to Wireless Interference

All the monitors do not encounter communication loss and meet the following requirements:

- The total delay of data transmission from the monitor to the CMS: ≤ 2 seconds.
- The delay for monitor-related settings configured at the CMS to be effective: ≤ 2 seconds.
- The total delay of data transmission from one monitor to the other: ≤ 2 seconds.
- The delay for the monitor to reset alarms of another to be effective: ≤ 2 seconds.

Testing conditions are as follows:

- Number of the monitors supported by a single AP: ≤ 16 .
- Each monitor can communicate with the CMS.
- Only one monitor can transmit history data.
- The weakest strength of the AP signal where the monitor is located is not less than -65 dBm.

- The distance between the interfering devices and the monitor is greater than 20 cm. A Wi-Fi interference (no greater than -85 dBm) in the same channel and a Wi-Fi interference (no greater than -50 dBm) in an adjacent-channel are presented synchronously. The interfering devices include, but are not limited to, 2.4 G wireless devices, cellular mobile networks, microwave ovens, interphones, cordless phones, and ESU equipment. The interfering devices do not include Wi-Fi devices.

A.7.2.2 Wi-Fi Network Stability

The ratio of the communication data loss on the CMS from any monitor does not exceed 0.1% over a 24-hour period. 12 of the 16 monitors connected to the network roam for 30 times.

Testing conditions are as follows:

- Number of the monitors supported by a single AP: ≤ 16 .
- Each monitor can communicate with the CMS.
- Only one monitor can transmit history data.
- The weakest strength of the AP signal where the monitor is located cannot be less than -65 dBm.

A.7.2.3 Distinct Vision Distance

The distinct vision distance between the monitor and the AP is no less than to 50 meters.

A.8 Measurement Specifications

The adjustable range of alarm limits is the same with the measurement range of signals unless otherwise specified.

A.8.1 ECG Specifications

ECG	
Standards	Meet standards of IEC 60601-2-27 and IEC 60601-2-25
Lead set	3-lead: I, II, III 5-lead: I, II, III, aVR, aVL, aVF, V
ECG standard	AHA, IEC
Display sensitivity	1.25 mm/mV ($\times 0.125$), 2.5 mm/mV ($\times 0.25$), 5 mm/mV ($\times 0.5$), 10 mm/mV ($\times 1$), 20 mm/mV ($\times 2$), 40 mm/mV ($\times 4$), Auto, less than 5% error
Sweep speed	6.25 mm/s, 12.5 mm/s, 25 mm/s, 50 mm/s, less than 5% error
Bandwidth (-3dB)	Diagnostic mode: 0.05 to 150 Hz Monitor mode: 0.5 to 40 Hz Surgical mode: 1 to 20 Hz ST mode: 0.05 to 40 Hz Emphasis mode: 2 to 18 Hz Customize mode: available high pass frequencies are 0.01Hz, 0.05Hz, 0.15Hz, 0.25Hz, 0.32Hz, 0.5Hz, 0.67Hz; available low pass frequencies are 25Hz, 35Hz, 45Hz, 75Hz, 100Hz, 150Hz.
Common mode rejection ratio	Diagnostic mode: >90 dB Monitor mode: >105 dB Surgical mode: >105 dB ST mode: >105 dB Emphasis mode: >105 dB Customize mode: >105 dB when the low-pass frequency < 40 Hz, >90 dB when the low-pass frequency > 40 Hz

Notch filter	50/60 Hz Monitor, surgical, ST, emphasis and customize mode: notch filter turns on automatically Diagnostic mode: notch filter is turned on/off manually
Differential input impedance	≥5 MΩ
Input signal range	±10 mV (peak-to-peak value)
Electrode offset potential tolerance	±800 mV
Input offset current	≤0.1 μA, (drive lead ≤1 μA)
Defibrillation protection	Enduring 5000V (360 J) charge without data loss or corruption Baseline recovery time: <5 s (after defibrillation) Polarization recovery time: <10 s Defibrillation energy absorption: ≤10% (100Ω load)
Animal leakage current	<10 uA
Calibration signal	1mV (peak-to-peak value) ±5%
ESU protection	Cut mode: 300 W Coagulate mode: 100 W Recovery time: ≤10s In compliance with the requirements in IEC 60601-2-27
Pace Pulse	
Pace pulse markers	Pace pulses meeting the following conditions are labelled with a PACE marker: Amplitude: ±2 to ±700 mV Width: 0.1 to 2 ms Rise time: 10 to 100 μs No overshoot
Pace pulse rejection	When tested in accordance with the IEC 60601-2-27: 201.12.1.101.13, the heart rate meter rejects all pulses meeting the following conditions. Amplitude: ±2 to ±700 mV Width: 0.1 to 2 ms Rise time: 10 to 100 μs No overshoot
HR	
Measurement range	15 bpm to 350 bpm
Resolution	1 bpm
Accuracy	±1 bpm or ±1%, whichever is greater.
Sensitivity	200 μV (lead II)
HR averaging method	In compliance with the requirements in Clause 201.7.9.2.9.101 b) 3) of IEC 60601-2-27, the following method is used: If the last 3 consecutive RR intervals are greater than 1200 ms, the 4 most recent RR intervals are averaged to compute the HR. Otherwise, heart rate is computed by subtracting the maximum and minimum ones from the most recent 12 RR intervals and then averaging them. The HR value displayed on the monitor screen is updated no more than one second.
Response to irregular rhythm	In compliance with the requirements in Clause 201.7.9.2.9.101 b) 4) of IEC 60601-2-27, the heart rate after 20 seconds of stabilization is displayed as follows: Ventricular bigeminy (waveform 3a): 80±1 bpm Slow alternating ventricular bigeminy (waveform 3b): 60±1 bpm Rapid alternating ventricular bigeminy (waveform 3c): 120±1 bpm Bidirectional systoles (waveform 3d): 90±2 bpm

Response time to heart rate change	Meets the requirements of IEC 60601-2-27: Clause 201.7.9.2.9.101 b) 5). From 80 to 120 bpm: less than 11s From 80 to 40 bpm: less than 11s	
Time to alarm for tachycardia	Meets the requirements in Clause 201.7.9.2.9.101 b) 6) of IEC 60601-2-27. Waveform 4ah-range: <11s 4a-range: <11s 4ad-range: <11s 4bh-range: <11s 4b-range: <11s 4bd-range: <11s	
Tall T-wave rejection capability	When the test is performed based on Clause 201.12.1.101.17 of IEC 60601-2-27, the heart rate calculation is not affected for QRS of 100 ms duration, T-wave duration of 180 ms and amplitude lower than 1.2 mV, and QT interval of 350 ms.	
Arrhythmia Analysis Classifications	Asystole, V-Fib/V-Tach, V-Tach, Vent Brady, Extreme Tachy, Extreme Brady, Vent Rhythm, PVCs/min, Pauses/min, Couplet, Bigeminy, Trigeminy, R on T, Run PVCs, PVC, Tachy, Brady, Missed Beat, Pacer Not Pacing, Pacer Not Capture, Multiform PVC, Nonsus V-Tach, Pause, Irr Rhythm, SVT, SVCs/min	
ST Segment Analysis		
Measurement range	-2.5 to 2.5 mV RTI	
Accuracy	-0.8 to 0.8 mV: Beyond this range:	±0.02 mV or ±10%, whichever is greater. Not specified.
Resolution	0.01mV	
QT/QTc Analysis		
Measurement range	QT: 200 to 800 ms QTc: 200 to 800 ms QT-HR: 15bpm to 180bpm	
Accuracy	QT: ±30 ms	
Resolution	QT: 4 ms QTc: 1 ms	
Alarm limit	Range	Step
HR High	HR≤40bpm: (low limit + 2 bpm) to 40 bpm HR > 40 bpm: (low limit + 5 bpm) to 295 bpm	HR≤40bpm: 1 bpm HR > 40 bpm: 5 bpm
HR Low	HR≤40bpm: 16 bpm to (high limit - 2 bpm) HR > 40 bpm: 40 bpm to (high limit - 5 bpm)	
ST High	(low limit + 0.2 mV) to 2.0 mV (ST alarm mode: Absolute) 0 mV to 2.0 mV (ST alarm mode: Relative)	0.05 mV
ST Low	-2.0 mV to (high limit - 0.2 mV) (ST alarm mode: Absolute) -2.0 mV to 0 mV (ST alarm mode: Relative)	
QTc High	200 to 800 ms	10 ms
ΔQTc High	30 to 200 ms	

A.8.2 Resp Specifications

Technique	Trans-thoracic impedance
Lead	Options are lead I, lead II and auto

Respiration excitation waveform	<300 μ A RMS, 64 kHz ($\pm$ 10%)	
Minimum respiration impedance threshold	0.3 Ω	
Baseline impedance range	200 to 2500 Ω (using an ECG cable with 1k Ω resistance)	
Respiration Rate		
Measurement range	0 to 150 rpm	
Resolution	1 rpm	
Accuracy	0 to 120 rpm: $\pm$1 rpm 121 to 150 rpm: $\pm$2 rpm	
Apnea alarm time	10 s, 15 s, 20 s, 25 s, 30 s, 35 s, 40 s	
Alarm limit	Range (rpm)	Step (rpm)
RR High	(low limit + 2) to 150	1
RR Low	0 to (high limit - 2)	

A.8.3 SpO₂ Specifications

Alarm limit	Range (%)	Step (%)
SpO ₂ High	(low limit + 2) to 100	1
SpO ₂ Low	(Desat+1) to (high limit - 2)	
SpO ₂ Desat Low	0 to (low limit - 1)	1

SpO₂ Module

Standards	Meet standards of ISO 80601-2-61
Measurement range	0 to 100%
Resolution	1%
Response time	< 30s (normal perfusion, no disturbance, SpO ₂ value sudden changes from 70% to 100%)
Accuracy	70 to 100%: $\pm$ 3%ABS 0% to 69%: Not specified.
Refreshing rate	$\leq$ 2s
Sensitivity	High, Medium, Low
PI	
Measurement range	0.05 to 20%
Resolution	PI<10.0: 0.01 PI $\geq$ 10.0: 0.1

A.8.4 PR Specifications

Alarm limit	Range	Step
PR High	PR≤40bpm: (low limit + 2 bpm) to 40 bpm PR > 40 bpm: (low limit + 5 bpm) to 295 bpm	PR≤40: 1 PR>40: 5
PR Low	PR≤40bpm: 16 bpm to (high limit - 2 bpm) PR > 40 bpm: 40 bpm to (high limit - 5 bpm)	

PR from SpO₂ Module

Measurement range	20 to 300 bpm
Resolution	1 bpm
Response time	<30 s (normal perfusion, no disturbance, PR value sudden changes from 25 to 240bpm)
Accuracy	±3 bpm
Refreshing rate	≤2 s

PR from NIBP Module

Measurement range	30 to 300 bpm
Resolution	1 bpm
Accuracy	±3bpm or ±3%, whichever is greater

PR from IBP Module

Measurement range	20 to 350 bpm
Resolution	1 bpm
Accuracy	±1 bpm or ±1%, whichever is greater

A.8.5 NIBP Specifications

Standard	Meet standard of IEC 80601-2-30			
Technique	Oscillometry			
Mode of operation	Manual, Auto, STAT, Sequence, Clock			
Auto mode repetition intervals	1min, 2min, 2.5min, 3min, 5min, 10min, 15min, 20min, 30min, 1h, 1.5h, 2h, 3h, 4h, 8h			
STAT mode cycle time	5 min			
Max measurement time	120s			
Measurement ranges (mmHg)		Weight (>23kg or >50 lb)	Weight(10 to 23 kg or 21 to 50 lb)	Weight (<10 kg or <21 lb)
	Systolic:	25 to 290	25 to 240	25 to 240
	Diastolic:	10 to 250	10 to 200	10 to 200
	Mean:	15 to 260	15 to 215	15 to 215
Accuracy	Max mean error: ±5 mmHg Max standard deviation: 8 mmHg			
Resolution	1mmHg			

Initial cuff inflation pressure range (mmHg)	Weight (>23kg or >50 lb): 80 to 280 Weight (10 to 23 kg or 21 to 50 lb): 80 to 210 Weight (<10 kg or <21 lb): 80 to 210	
Default initial cuff inflation pressure (mmHg)	Weight (>23kg or >50 lb): 160 Weight (10 to 23 kg or 21 to 50 lb): 140 Weight (<10 kg or <21 lb): 140	
Software overpressure protection	297±3 mmHg	
Hardware overpressure protection	≤330 mmHg	
Static pressure measurement range	0 mmHg to 300 mmHg	
Static pressure measurement accuracy	±3 mmHg	
Alarm limit	Range (mmHg)	Step (mmHg)
NIBP-S High	Weight (>23kg or >50 lb): 25 to 290 Weight (10 to 23 kg or 21 to 50 lb): 25 to 240 Weight (<10 kg or <21 lb): 25 to 240	5
NIBP-S Low	25 to (high limit - 5)	
NIBP-M High	Weight (>23kg or >50 lb): 15 to 260 Weight (10 to 23 kg or 21 to 50 lb): 15 to 215 Weight (<10 kg or <21 lb): 15 to 215	
NIBP-M Low	15 to (high limit - 5)	
NIBP-D High	Weight (>23kg or >50 lb): 10 to 250 Weight (10 to 23 kg or 21 to 50 lb): 10 to 200 Weight (<10 kg or <21 lb): 10 to 200	
NIBP-D Low	10 to (high limit - 5)	

A.8.6 Temp Specifications

Technique	Thermal resistance	
Operating mode	Direct mode	
Measurement range	0 to 50 °C (32 to 122 °F)	
Resolution	0.1°C	
Accuracy	±0.1 °C or ±0.2 °F (excluding sensor)	
Refreshing rate	≤2s	
Minimum time for accurate measurement	Body cavity: <80 s	
Alarm limit	Range	Step
TXXHigh (XX refers to temperature site)	(low limit +1.0) to 50.0 °C	0.1 °C 0.1 °F
TXXLow (XX refers to temperature site)	0.1 to (high limit - 1.0) °C	
ΔT High	0.1 to 50.0 °C	

A.8.7 IBP Specifications

Standard	Meet the standard of IEC 60601-2-34
Technique	Direct invasive measurement
IBP	

Measurement range	-50 to 300 mmHg	
Resolution	1 mmHg	
Accuracy	±2% or ±1 mmHg, whichever is greater (excluding sensor error)	
Refreshing rate	≤2s	
PPV		
Measurement range	0% to 50%	
PAWP		
Measurement range	-50 to 300mmHg	
Pressure transducer		
Excitement voltage	5 VDC, ±2%	
Sensitivity	5 μV/V/mmHg	
Zero adjustment range	±200 mmHg	
Impedance range	300 to 3000Ω	
Volume displacement	<0.04 mm ³ /100 mmHg	
Alarm limit	Range (mmHg)	Step (mmHg)
Sys High	(low limit + 2) to 300	1
Mean High		
Dia High		
Sys Low	-50 to (high limit - 2)	
Mean Low		
Dia Low		

A.8.8 C.O. Specifications

Standard	Meet the standard of ISO 80601-2-56	
Measurement method	Thermodilution method	
Measurement range	C.O.: 0.1 to 20 L/min TB: 23 to 43 °C TI: 0 to 27 °C	
Resolution	C.O.: 0.1 L/min TB, TI: 0.1 °C	
Accuracy	C.O.: ±5% or ±0.1 L /min, whichever is greater TB, TI: ±0.1 °C (without sensor)	
Minimum time for accurate TB measurement	10s	
Repeatability	±2% or ±0.1 L/min, whichever is greater	
Alarm limit	Range(mmHg)	Step
TB High	(low limit + 1) to 43 °C (low limit + 2) to 109.4 °F	0.1 °C 0.1 °F
TB Low	23 to (high limit - 1) °C 73.4 to (high limit - 2) °F	

A.8.9 CO₂ Specifications

Measurement mode	Sidestream, Mainstream	
Apnea time	10s, 15s, 20s, 25s, 30s, 35s, 40s	
Alarm limit	Range	Step
EtCO ₂ High	(low limit + 2) to 99	1 mmHg
EtCO ₂ Low	1 to (high limit - 2)mmHg	
FiCO ₂ High	1 to 99 mmHg	

Sidestream CO₂ Module

Standard	Meet the standard of ISO 80601-2-55	
CO ₂ Measurement range	0 to 150 mmHg	
CO ₂ absolute accuracy*	Full accuracy mode: 0 to 40 mmHg: ± 2 mmHg 41 to 76 mmHg: ±5% of reading 77 to 150 mmHg: ±10% of reading ISO accuracy mode: add ± 2mmHg to the full accuracy mode	
Inaccuracy specifications are affected by the breath rate and I:E. The EtCO ₂ accuracy is within specification for breath rate ≤ 60 rpm and I/E ratio ≤ 1:1, or breath rate ≤ 30 rpm and I/E ratio ≤ 2:1.		
CO ₂ resolution	1 mmHg	
Accuracy drift	Meet the requirement for measurement accuracy within 6 hours	
Sample flow rate tolerance	±15% or ±15 ml/min, whichever is greater.	
Start-up time	Maximum: 90 s	
Response time	Measured with DRYLINE II small water trap and a 2.5-meter small sampling line: ≤ 5.0s @70ml/min Measured with DRYLINE II small water trap and a 2.5-meter small sampling line: ≤ 4.5s @90ml/min Measured with DRYLINE II large water trap and a 2.5-meter large sampling line: ≤ 5.0s @120ml/min	
Rise time	Measured with DRYLINE II small water trap and a 2.5-meter small sampling line: ≤ 250ms@70ml/min Measured with DRYLINE II small water trap and a 2.5-meter small sampling line: ≤ 250ms@90ml/min Measured with DRYLINE II large water trap and a 2.5-meter large sampling line: ≤ 300ms@120ml/min	
awRR measurement range	0 to 150 rpm	
awRR measurement precision	≤60 rpm: ±1 61 to 150 rpm: ±2	
awRR resolution	1 rpm	
Effect of interference gases on CO ₂ measurements		
Gas	Concentration (%)	Quantitative effect*

N ₂ O	≤60	±1 mmHg
Hal	≤4	
Sev	≤5	
Iso	≤5	
Enf	≤5	
Des	≤15	±2 mmHg
O ₂	≤100	±1 mmHg
*: means an extra error should be added in case of gas interference when CO ₂ measurements are performed between 0 to 40mmHg.		

Mainstream CO₂ Module

Standard	Meet the standard of ISO 80601-2-55	
CO ₂ Measurement range	0 to 150 mmHg	
Accuracy	0 to 40 mmHg: ±2 mmHg 41 to 70 mmHg: ±5% of the reading 71 to 100 mmHg: ±8% of the reading 101 to 150 mmHg: ±10% of the reading	
Accuracy drift	Meet the requirement for measurement accuracy within 6 hours	
Resolution	1 mmHg	
Rise time	<60 ms	
Response time	<2s	
Data sample rate	100 Hz	
awRR measurement range	0 to 150 rpm	
awRR measurement accuracy	±1 rpm	
awRR resolution	1 rpm	

A.9 Software Operating Environment

Software operating environment: Linux, OpenSSL.

B

EMC and Radio Regulatory Compliance

B.1 EMC

The system complies with the EMC standard IEC 60601-1-2:2014+A1:2020.

WARNING

- The use of unapproved accessories may diminish system performance.
- Use of components, accessories, probes, and cables other than those specified may result in increased emission or decreased immunity of system.
- The system needs special precautions regarding EMC and needs to be installed and put into service according to the EMC information provided below.
- Use of this equipment adjacent to or stacked with other equipment should be avoided because it could result in improper operation. If such use is necessary, this equipment and the other equipment should be observed to verify that they are operating normally.
- Use of accessories, transducers and cables other than those specified or provided by the manufacturer of this equipment could result in increased electromagnetic emissions or decreased electromagnetic immunity of this equipment and result in improper operation.
- Portable RF communications equipment (including peripherals such as antenna cables and external antennas) should be used no closer than 30 cm (12 inches) to any part of the system, including cables specified by the manufacturer. Otherwise, degradation of the performance of this equipment could result.
- Other devices may interfere with this equipment even though they meet the requirements of CISPR.
- When the input signal is below the minimum amplitude provided in technical specifications, erroneous measurements could result.
- Use of portable or mobile communications devices can degrade the performance of the equipment.
- This device is intended for use in professional healthcare facility environment. If it is used in special environment, such as magnetic resonance imaging environment, the equipment/system may be disrupted by the operation of nearby equipment.

If the system is operated within the electromagnetic environment listed in TABLE EMC-2, EMC-3 and TABLE EMC-4, the system will remain safe and will provide the following basic performances:

- Operating mode
- Accuracy
- Function
- Accessories identification
- Data stored
- Alarm
- Detect for connection

TABLE EMC-1

GUIDANCE AND DECLARATION—ELECTROMAGNETIC EMISSIONS		
The system is intended for use in the electromagnetic environment specified below. The customer or the user of system should assure that it is used in such an environment.		
EMISSIONS TEST	COMPLIANCE	ELECTROMAGNETIC ENVIROMENT – GUIDANCE
RF Emissions CISPR 11	Group 1	The system uses RF energy only for its internal function. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.

GUIDANCE AND DECLARATION—ELECTROMAGNETIC EMISSIONS		
RF Emissions CISPR 11	Class A	The system is suitable for use in all establishments other than domestic and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
Harmonic Emissions IEC 61000-3-2	Not applicable	
Voltage Fluctuations/ Flicker Emissions IEC 61000-3-3	Not applicable	

TABLE EMC-2

GUIDANCE AND DECLARATION—ELECTROMAGNETIC IMMUNITY			
The system is intended for use in the electromagnetic environment specified below. The customer or the user of system should assure that it is used in such an environment.			
IMMUNITY TEST	IEC 60601 TEST LEVEL	COMPLIANCE LEVEL	ELECTROMAGNETIC ENVIROMENT – GUIDANCE
Electrostatic Discharge (ESD) IEC 61000-4-2	±8 kV contact; ±2 kV, ±4 kV, ±8 kV, ±15 kV air	±8 kV contact; ±2 kV, ±4 kV, ±8 kV, ±15 kV air	Floors should be wood, concrete or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.
Electrical fast Transient / burst IEC 61000-4-4	±2 kV for power supply lines; ±1 kV for input/ output lines	±2 kV for power supply lines; ±1 kV for input/ output lines	Mains power quality should be that of a typical commercial or hospital environment.
Surge IEC 61000-4-5	±0,5 kV, ±1 kV line(s) to line(s); ±0,5 kV, ±1 kV, ±2 kV line(s) to earth	±0,5 kV, ±1 kV line(s) to line(s); ±0,5 kV, ±1 kV, ±2 kV line(s) to earth	Mains power quality should be that of a typical commercial or hospital environment.
Voltage dips, Short interruptions and voltage variation on power supply input voltage IEC 61000-4-11	0 % U_T ; 0,5 cycle At 0°, 45°, 90°, 135°, 180°, 225°, 270° and 315° 0 % U_T ; 1 cycle 70% U_T for 25/30 cycle at 0° 0 % U_T ; 250/300 cycle	0 % U_T ; 0,5 cycle At 0°, 45°, 90°, 135°, 180°, 225°, 270° and 315° 0 % U_T ; 1 cycle 70% U_T for 25/30 cycle at 0° 0 % U_T ; 250/300 cycle	Mains power quality should be that of a typical commercial or hospital environment. If you require continued operation during power mains interruptions, it is recommended that our product be powered from an uninterruptible power supply or a battery.
Power frequency (50/60 HZ) magnetic field IEC 61000-4-8	30 A/m	30 A/m	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.
NOTE: U_T is the A.C. mains voltage prior to application of the test level.			

TABLE EMC-3

GUIDANCE AND DECLARATION—ELECTROMAGNETIC IMMUNITY			
The system is intended for use in the electromagnetic environment specified below. The customer or the user of system should assure that it is used in such an environment.			
IMMUNITY TEST	IEC 60601 TEST LEVEL	COMPLIANCE LEVEL	ELECTROMAGNETIC ENVIROMENT – GUIDANCE

GUIDANCE AND DECLARATION—ELECTROMAGNETIC IMMUNITY			
Conducted RF IEC 61000-4-6	3 Vrms 0,15 MHz – 80 MHz 6 Vrms in ISM bands ^a between 0,15 MHz and 80 MHz	3 Vrms 0,15 MHz – 80 MHz 6 Vrms in ISM bands ^a between 0,15 MHz and 80 MHz	Portable and mobile RF communications equipment should be used no closer to any part of system, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. Recommended separation distance: $d = 1.2 \times \sqrt{P} \quad 0,15 \text{ MHz to } 80 \text{ MHz}$ $d = 2 \times \sqrt{P} \quad 0,15 \text{ MHz to } 80 \text{ MHz}$ $d = 1.2 \times \sqrt{P} \quad 80 \text{ MHz to } 800 \text{ MHz}$ $d = 2.3 \times \sqrt{P} \quad 800 \text{ MHz to } 2.7 \text{ GHz}$ Where, P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and d is the recommended separation distance in meters (m).
Radiated RF IEC 61000-4-3	3 V/m 80MHz - 2.7GHz	3 V/m 80MHz - 2.7GHz	Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey^b, should be less than the compliance level in each frequency range^c. Interference may occur in the vicinity of equipment marked with the following symbol: 
Note 1: At 80 MHz and 800 MHz, the higher frequency range applies. Note 2: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.			
^aThe ISM (industrial, scientific, and medical) bands between 150 kHz and 80 MHz are 6,765 MHz to 6,795 MHz; 13,553 MHz to 13,567 MHz; 26,957 MHz to 27,283 MHz; and 40,66 MHz to 40,70 MHz. The amateur radio bands between 0,15 MHz and 80 MHz are 1,8 MHz to 2,0 MHz, 3,5 MHz to 4,0 MHz, 5,3 MHz to 5,4 MHz, 7 MHz to 7,3 MHz, 10,1 MHz to 10,15 MHz, 14 MHz to 14,2 MHz, 18,07 MHz to 18,17 MHz, 21,0 MHz to 21,4 MHz, 24,89 MHz to 24,99 MHz, 28,0 MHz to 29,7 MHz and 50,0 MHz to 54,0 MHz. ^b Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the device is used exceeds the applicable RF compliance level above, the device should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as re-orienting or relocating the device. ^c Over the frequency ranges 150 kHz to 80 MHz, field strengths should be less than 3V/m.			

TABLE EMC-4

GUIDANCE AND DECLARATION—ELECTROMAGNETIC IMMUNITY			
The system is intended for use in the electromagnetic environment specified below. The customer or the user of system should assure that it is used in such an environment.			
IMMUNITY TEST	IEC 60601 TEST LEVEL	COMPLIANCE LEVEL	ELECTROMAGNETIC ENVIROMENT – GUIDANCE
Proximity magnetic fields IEC 61000-4-39	65 A/m 134,2 kHz Pulse modulation 2,1 kHz	65 A/m 134,2 kHz Pulse modulation 2,1 kHz	/
	7,5 A/m 13,56 MHz Pulse modulation 50 kHz	7,5 A/m 13,56 MHz Pulse modulation 50 kHz	

TABLE EMC-5 Test specifications and minimum distances

Recommended separation distances between portable and mobile RF communications equipment and Monitor						
The system is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of Monitor can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the Monitor as recommended below, according to the maximum output power of the communications equipment. Portable and mobile radio communications equipment (e.g. two-way radio, cellular/ cordless telephones and similar equipment) should be used no closer to any part of this system, including cables, than determined according to the following method:						
Test frequency (MHz)	Band (MHz)	Service	Modulation	Maximum power (W)	Distance (m)	Immunity test level (V/m)
385	380 - 390	TETRA 400	Pulse modulation 18Hz	1.8	0.3	27
450	430 -470	GMRS 460 FRS 460	FM ± 5 kHz deviation 1 kHz sine	2	0.3	28
710	704 - 787	LTE Band 13,17	Pulse modulation 217 Hz	0.2	0.3	9
745						
780						
810	800 - 960	GSM 800/ 900, tetra 800, iDEN 820, CDMA 850, LTE Band 5	Pulse modulation 18 Hz	2	0.3	28
870						
930						
1720	1700 -1990	GSM 1800, CDMA 1900, GSM 1900, DECT, LTE Band 1, 3,4,25,UMTS	Pulse modulation 217 Hz	2	0.3	28
1845						
1970						
2450	2400 -2570	Bluetooth, WLAN, 802.11 b/g/n, RFID 2450, LTE Band 7	Pulse modulation 217 Hz	2	0.3	28
5240	5100 -5800	WLAN, 802.11 a/n	Pulse modulation 217 Hz	0.2	0.3	9
5500						
5785						

TABLE EMC-6

RECOMMENDED SEPARATION DISTANCES BETWEEN PORTABLE AND MOBILE RF COMMUNICATION DEVICE AND THE SYSTEM				
The system is intended for use in an electromagnetic environment in which radiated RF disturbance are controlled. The customer or the user of system can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communication equipment (transmitters) and system as recommended below, according to the maximum output power of the communication equipment.				
Rated Maximum Output power of Transmitter (W)	Separation Distance According to Frequency of Transmitter			
	150kHz -80MHz Out ISM bands $d=1.2 \sqrt{P}$	150kHz -80MHz in ISM bands $d=2 \sqrt{P}$	80MHz-800MHz $d=1.2 \sqrt{P}$	800MHz-2.7GHz $d=2.3 \sqrt{P}$
0.01	0.12	0.2	0.12	0.23
0.1	0.38	0.64	0.38	0.73
1	1.2	2	1.2	2.3
10	3.8	6.4	3.8	7.3
100	12	20	12	23
For transmitters at a maximum output power not listed above, the recommended separation distance in meters (m) can be determined using the equation applicable to the frequency of the transmitter, where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer.				
Note 1: At 80 MHz and 800 MHz, the higher frequency range applies.				
Note 2: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.				

B.2 Radio Regulatory Compliance



The radio device used in this product is in compliance with the essential requirements and other relevant provisions of Directive 2014/53/EU.

This device complies with part 15 of the FCC Rules and with RSS-210 of Industry Canada. Operation is subject to the condition that this device does not cause harmful interference.

This device must accept any interference received, including interference that may cause undesired operation.

WARNING

- **Keep a distance of at least 20cm away from the monitor when Wi-Fi function is in use.**

C

Default Settings

C.1 Parameters Default Settings

C.1.1 ECG Default Settings

Item		Default Setting
HR/PR	Alarm switch (On/Off)	On
	High limit	Canine: 160 bpm Feline: 180 bpm Other: 160 bpm
	Low limit	Canine: 60 bpm Feline: 100 bpm Other: 60 bpm
	Priority	Med
	Alarm Outputs	Off
	Alarm Source	Auto
Extreme Tachy	Alarm switch (On/Off)	On
	High limit	Canine: 180 bpm Feline: 200 bpm Other: 180 bpm
	Priority	High
	Alarm Outputs	Off
Extreme Brady	Alarm switch (On/Off)	On
	Low limit	Canine: 50 bpm Feline: 90 bpm Other: 50 bpm
	Priority	High
	Alarm Outputs	Off
Alarm Source		Auto
ECG1		II
ECG Gain		×2
Speed		25 mm/sec
Filter		Surgery
Notch Filter		On
Lead Set		Auto
Smart Lead		On
Baseline Drift Removal		On
Waveform Layout		Standard
QRS Volume		2
QRS Threshold		0.16 mV

Item	Default Setting
Paced	No
Pacer Reject	Off

C.1.2 Arrhythmia Default Settings

Arrhythmia Alarm Default Settings

Item	Alarm Switch	Priority	Alarm Outputs
Asystole	On	High, unadjustable	Off
V-Fib/V-Tach	On	High, unadjustable	Off
V-Tach	On	High, unadjustable	Off
Vent Brady	On	High, unadjustable	Off
Extreme Tachy	On	High, unadjustable	Off
Extreme Brady	On	High, unadjustable	Off
R on T	Off	Med	Off
Run PVCs	Off	Low	Off
Couplet	Off	Prompt	Off
Multiform PVC	Off	Med	Off
PVC	Off	Prompt	Off
Bigeminy	Off	Med	Off
Trigeminy	Off	Med	Off
Tachy	Off	Med	Off
Brady	Off	Med	Off
Pacer Not Capture	Off	Prompt	Off
Pacer Not Pacing	Off	Prompt	Off
Missed Beat	Off	Prompt	Off
Nonsus V-Tach	Off	Med	Off
Vent Rhythm	Off	Med	Off
Pause	Off	Low	Off
Irr Rhythm	Off	Prompt	Off
PVCs/min	Off	Med	Off
Pauses/min	Off	Med	Off
SVT	Off	Med	Off
SVCs/min	Off	Med	Off

Arrhythmia Threshold Default Settings

Item	Default Setting
Asystole Delay	5 sec

Item	Default Setting
Tachy	Canine: 160 bpm Feline: 180 bpm Other: 160 bpm
Brady	Canine: 60 bpm Feline: 100 bpm Other: 60 bpm
Extreme Tachy	Canine: 180 bpm Feline: 200 bpm Other: 180 bpm
Extreme Brady	Canine: 50 bpm Feline: 90 bpm Other: 50 bpm
Multif PVCs Window	15 beats
PVCs/min	10
Pauses/min	8
Pause Threshold	2.0 sec
Irr Rhy End Time	2 min
SVT HR (bpm)	Canine: 180 bpm Feline: 240 bpm Other: 180 bpm
SVT SVCs (beats)	3
SVCs /min	10
Refractory Period 1	3 min
Refractory Period 2	10 min

C.1.3 ST Default Settings

Item		Default Setting
ST Alarm Mode		Absolute
ST-I, ST-II, ST-III, ST-aVR, ST-aVL, ST-aVF (ST Alarm Mode set to Absolute)	Alarm switch (On/Off)	Off
	High limit	0.2 mV
	Low limit	-0.2 mV
	Priority	Med
	Alarm Outputs	Off
ST Single, ST Dual (ST Alarm Mode set to Relative)	Alarm switch (On/Off)	Off
	High limit	0.1 mV
	Low limit	-0.1 mV
	Priority	Med
	Alarm Outputs	Off
ST Analysis		Off
ST Segment		Auto
Show Markers		Off

Item	Default Setting
ST Point	J+60 ms
Auto Adjust	On
ISO	-80
J	48

C.1.4 QT Default Settings

Item	Default Setting
QTc	Alarm switch (On/Off)
	Off
	High limit
	460
ΔQTc	Priority
	Med
	Alarm Outputs
	Off
ΔQTc	Alarm switch (On/Off)
	Off
	High limit
	60
ΔQTc	Priority
	Med
	Alarm Outputs
	Off
QT Analysis	Off
QT Leads	All

C.1.5 Respiration Default Settings

Item	Default Setting
RR	Alarm switch (On/Off)
	On
	High limit
	30
	Low limit
Apnea	6
	Priority
	Med
	Alarm Outputs
	Off
Apnea	Alarm switch (On/Off)
	On
	Priority
Apnea	High, unadjustable
	Alarm Outputs
	Off
Apnea Delay	15s
RR Source	Auto
Resp Lead	II
Gain	×2
Speed	6.25 mm/s
Auto Threshold Detection	On

C.1.6 SpO₂ Default Settings

Item		Default Setting
SpO2	Alarm switch (On/Off)	On
	High limit	100%
	Low limit	95%
	Priority	Med
	Alarm Outputs	Off
SpO2 Desat	Alarm switch (On/Off)	On
	Low limit	85%
	Priority	High
	Alarm Outputs	Off
NIBP Simul		Off
Sensitivity		Med
Display PI		On
Speed		25 mm/s
PR	Alarm switch (On/Off)	On
	High limit	Canine: 160 bpm Feline: 180 bpm Other: 160 bpm
	Low limit	Canine: 60 bpm Feline: 100 bpm Other: 60 bpm
	Priority	Med
	Alarm Outputs	Off
	Alarm Source	Auto
	PR Source	Auto
	QRS Volume	2
	Display PR	On

C.1.7 Temperature Default Settings

Item		Default Setting
TXX (XX refers to temperature site)	Alarm switch (On/Off)	On
	High limit	40°C
	Low limit	Canine: 36 °C Feline: 37 °C Other: 36 °C
	Priority	Med
	Alarm Outputs	Off

Item		Default Setting
ΔT	Alarm switch (On/Off)	On
	High limit	2.0 °C
	Priority	Med
	Alarm Outputs	Off

C.1.8 NIBP Default Settings

Item		Default Setting
NIBP-S	Alarm switch (On/Off)	On
	High limit	160 mmHg
	Low limit	80 mmHg
	Priority	Med
	Alarm Outputs	Off
NIBP-D	Alarm switch (On/Off)	On
	High limit	90 mmHg
	Low limit	Canine: 55 mmHg Feline: 60 mmHg Other: 55 mmHg
	Priority	Med
	Alarm Outputs	Off
NIBP-M	Alarm switch (On/Off)	On
	High limit	100 mmHg
	Low limit	Canine: 60 mmHg Feline: 65 mmHg Other: 60 mmHg
	Priority	Med
	Alarm Outputs	Off
Initial Pressure		Weight (>23kg): 160 mmHg Weight (0.5 to 23 kg): 140 mmHg
Interval		5 min
Start Mode		Interval
NIBP End Tone		Off
Venipuncture Pressure		Auto
Display Format		Sys/Dia(Mean)
Display Alarm Limits		Off
Display PR		Off

C.1.9 IBP Default Settings

Item		Default Setting
IBP-S	Alarm switch (On/Off)	On
	High limit	- Art/Ao/UAP/BAP/FAP/LV/P1-P4 arterial pressure: 160 mmHg - PA: 38 mmHg
	Low limit	- Art/Ao/UAP/BAP/FAP/LV/P1-P4 arterial pressure: 100 mmHg - PA: 5 mmHg
	Priority	Med
	Alarm Outputs	Off
IBP-D	Alarm switch (On/Off)	On
	High limit	Ao/UAP/BAP/FAP/LV/P1-P4 arterial pressure: 90 mmHg PA: 4 mmHg Art: 70 mmHg
	Low limit	Art: - Canine: 50 mmHg - Feline: 55 mmHg - Other: 50 mmHg Ao/UAP/BAP/FAP/LV/P1-P4 arterial pressure: 50 mmHg PA: -4 mmHg
	Priority	Med
	Alarm Outputs	Off
IBP-M	Alarm switch (On/Off)	On
	High limit	- Ao/UAP/BAP/FAP/LV/P1-P4 arterial pressure: 130 mmHg - PA: 16 mmHg - RAP/LAP/UDP/P3/P4 venous pressure: 7 mmHg - CVP: 9.8 cmH₂O - Art: 100 mmHg
	Low limit	Canine/Feline/Other: - Ao/UAP/BAP/FAP/LV/P1-P4 arterial pressure: 70 mmHg - PA: 12 mmHg - RAP/LAP/UDP/P3/P4 venous pressure: 0 mmHg - CVP: 0 cmH₂O Art: - Canine: 60 mmHg - Feline: 65 mmHg - Other: 60 mmHg
	Priority	Med
	Alarm Outputs	Off
CPP	Alarm switch (On/Off)	On
	High limit	130 mmHg
	Low limit	50 mmHg
	Priority	Med
	Alarm Outputs	Off
Measure (for P1, P2)		All
Measure (for P3, P4)		Mean Only
Sensitivity		Med
Speed		25 mm/sec

Item		Default Setting
Scale	ICP/RAP/LAP/UDP venous pressure	0-20 mmHg
	Art/Ao/BAP/FAP/LV/P1-P4 arterial pressure	0-160 mmHg
	UAP/P3/P4 venous pressure	0-80 mmHg
	PA/CVP	PA: 0-30 mmHg CVP: 0-30 cmH ₂ O
PPV Measure		Off
PPV Source		Auto
PAWP	Reference Waveform 1	II
	Reference Waveform 2	Resp
	Speed	12.5 mm/sec
	PA Scale (mmHg)	0-30
Overlapping Waveform Setup	Left Scale (mmHg)	0-160
	Right Scale (mmHg)	0-20
	CVP Scale (cmH ₂ O)	0-30
	PA Scale (mmHg)	0-30
	Speed	25 mm/sec
	Gridlines	Off
Display Format		Sys/Dia(Mean)
Display Alarm Limits		Off
Use PA-D as PAWP		Off

C.1.10 C.O. Default Settings

Item		Default Setting
TB	Alarm switch (On/Off)	On
	High limit	39.0 °C
	Low limit	36.0 °C
	Priority	Med
	Alarm Outputs	Off
Comp Const		0.542
Auto Start		On
Auto TI		On

C.1.11 CO₂ Default Settings

C.1.11.1 General Settings

Item		Default Setting
EtCO ₂	Alarm switch (On/Off)	On
	High limit	Canine: 55 mmHg Feline: 50 mmHg Other: 55 mmHg
	Low limit	Canine: 35 mmHg Feline: 30 mmHg Other: 35 mmHg
	Priority	Med
	Alarm Outputs	Off
FiCO ₂	Alarm switch (On/Off)	On
	High limit	5 mmHg
	Priority	Med
	Alarm Outputs	Off
Apnea Delay		15s
RR Source		Auto
Speed		6.25 mm/s
Scale		50 mmHg
Waveform Type		Draw

C.1.11.2 Sidestream CO₂ Default Settings

Item	Default Setting
BTPS Compensation	Off
O ₂ Compensation	90%
AG Compensation	0%
N ₂ O Compensation	0%
Auto Standby	60 min
Operating Mode	Measure

C.1.11.3 Mainstream CO₂ Default Settings

Item	Default Setting
Maximum Hold	10 sec
O ₂ Compensation	Off
Balance Gas	Room Air
AG Type	Sev
AG Compensation	0%
Operating Mode	Measure

C.2 Routine Default Settings

C.2.1 Audio Settings

Item	Default Setting
Alarm Volume	2
High Alarm Volume	Alarm Volume+3
QRS Volume	2
Key Volume	2
Reminder Volume	2

C.2.2 Display Settings

Item	Default Setting
Brightness	5
Brightness On Battery	1

C.2.3 System Time Settings

Item	Default Setting
Date Format	yyyy-mm-dd
24-Hour Time	On
Daylight Savings Time	Off

C.2.4 Other Settings

Item	Default Setting
Screen Lock Duration	Permanent
eStart	On

C.3 Review Default Settings

Item		Default Setting
Tabular Trends	Trend Group	Standard
	Interval	30 min
Graphic Trends	Trend Group	Standard
	Zoom	1 hrs
	Trends	5
Events	Filter	All
	Beat Anno:	Off
	Speed	25 mm/s
	Gain	×2

Item		Default Setting
Full Disclosure	Display(Maximum: 3)	II
	Storage	II
	Duration	1 min
	Scale	×1
	Beat Anno:	Off
	Speed	25 mm/sec
	Gain	×1

C.4 Minitrends Default Settings

Item	Default Setting
Alarm Statistics	On
Alarm Statistics Duration	8 hrs
Minitrend Length	2 hrs
Routine Vital	Manual
Time (for Routine Vital set to Auto)	08:00
Interval (for Routine Vital set to Auto)	8 hrs

C.5 Report Default Settings

C.5.1 Report Setup

Item		Default Setting
ECG Report	Amplitude	10 mm/mV
	Speed	25 mm/sec
Realtime Report	Speed	Auto
	Select Waveform	Current Waveforms
Tabular Trends Report	Period	Auto
	Interval	Auto
	Report Format	Landscape
	Trend Group	Standard
Graphic Trends	Period	Auto
	Trend Group	Standard

C.5.2 Record Setup

Item	Default Setting
Waveform 1	I
Waveform 2	II
Waveform 3	Off

Item	Default Setting
IBP Overlap	Off
Recording Duration	8 sec
Interval	Off
Recorder Paper Speed	25 mm/sec

C.6 Calculations Default Settings

Item			Default Setting
Drug	Calculator	Weight Based	Off
		Drug Amount	mcg
		Solution Volume	ml
		Dose	mcg/min
		Concentration	mcg/ml
		Infusion Time	hr
		Infusion Rate	ml/hr
	Titration Table	Dose Type	Dose/hr
		Interval	1

D Alarm Messages

D.1 Physiological Alarm Messages

This section lists physiological alarms, their default priority, and the actions that can be taken when an alarm occurs.

D.1.1 General Physiological Alarm Messages

Alarm messages	Default priority	Cause and solution
XX High	Med	XX value has risen above the high alarm limit or fallen below the low alarm limit. Check the animal's condition and check if the species and alarm limit settings are correct.
XX Low	Med	

Note: XX represents a measurement or parameter label, such as HR, NIBP, PVCs, RR, SpO2, PR, and so on.

D.1.2 Arrhythmia Alarm Messages

Alarm message	Default priority
Asystole	High
V-Fib/V-Tach	High
V-Tach	High
Vent Brady	High
Extreme Tachy	High
Extreme Brady	High
PVCs/min	Med
Pauses/min	Med
R on T	Med
Bigeminy	Med
Trigeminy	Med
Tachy	Med
Brady	Med
Multiform PVC	Med
Vent Rhythm	Med
Nonsus V-Tach	Med
Run PVCs	Low
Pause	Low
Couplet	Prompt
PVC	Prompt
Irr Rhythm	Prompt
Pacer Not Pacing	Prompt
Pacer Not Capture	Prompt

Alarm message	Default priority
Missed Beat	Prompt
SVT	Med
SVCs/min High	Med

Note: When arrhythmia alarms occur, check the animal's condition and the ECG connections.

D.1.3 ST Physiological Alarm Messages

ST alarm mode	Alarm messages	Default priority	Cause and solution
Absolute	ST-XX High	Med	The ST value of respective ECG lead has risen above the high alarm limit or fallen below the low alarm limit. Check the animal's condition and check if the species and alarm limit settings are correct.
	ST-XX Low	Med	
Relative	ST Single	Med	ST value of any ECG leads has risen above the high alarm limit or fallen below the low alarm limit. Check the animal's condition and check if the species and alarm limit settings are correct.
	ST Dual	Med	ST values of two or more ECG leads have risen above the high alarm limit or fallen below the low alarm limit. Check the animal's condition and check if the species and alarm limit settings are correct.

Note: XX represents the ECG lead label.

D.1.4 Resp Physiological Alarm Messages

Alarm message	Default priority	Cause and solution
Resp Artifact	High	The animal's heartbeat has interfered with his respiration. Check the animal's condition and the Resp connections.
Apnea	High	The respiration signal was so weak that the monitor cannot perform respiration analysis. Check the animal's condition, module and animal connections.

D.1.5 SpO₂ Physiological Alarm Messages

Alarm message	Default priority	Cause and solution
SpO ₂ Desat	High	The SpO ₂ value falls below the desaturation alarm limit. Check the animal's condition and check if the alarm limit settings are correct.

D.1.6 PR Physiological Alarm Messages

Alarm message	Default priority	Cause and solution
No Pulse	High	The pulse signal was so weak that the monitor cannot perform pulse analysis. Check the animal's condition, SpO ₂ sensor and measurement site.

D.1.7 NIBP Physiological Alarm Messages

Alarm message	Default priority	Cause and solution
NIBP-S Extremely High/ NIBP-D Extremely High/ NIBP-M Extremely High	High	The NIBP value is higher than the NIBP Extreme alarm high limit. Check the animal's condition and check if the alarm limit settings are correct.
NIBP-S Extremely Low/ NIBP-D Extremely Low/ NIBP-M Extremely Low	High	The NIBP value is lower than the NIBP Extreme alarm low limit. Check the animal's condition and check if the alarm limit settings are correct.

D.2 Technical Alarm Messages

This section lists technical alarms, their default priority, indication on alarm reset, and the actions that can be taken when an alarm occurs.

Technical alarms give different alarm indicators when the alarm system is reset. In this section we classify the technical alarms into three categories for easy clarification:

- A: technical alarms are cleared. The monitor gives no alarm indications.
- B: technical alarms are changed to the prompt messages.
- C: the alarm is silenced and a √ appears before the alarm message.

In the following tables we will use A, B, and C to refer to the indications on alarm reset.

D.2.1 General Technical Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
XX Module Error	High	C	XX module does not work properly. Restart the monitor, if the alarm persists, contact the Customer Service Department or your local distributor.

Note: XX represents a measurement or parameter label, such as HR, RR, SpO₂, EtCO₂, and so on.

D.2.2 ECG Technical Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
ECG Noisy	Low/Prompt	A	The ECG signal is noisy. Check for any possible sources of signal noise around the cable and electrode, and check the animal for excessive motion.
ECG Amplitude Too Small	Low	C	The ECG amplitude does not reach the detected threshold. Check for any possible source of interference around the cable and electrode.
ECG Lead Off	Low	B	The electrode has become detached from the animal or the lead wire has become disconnected from the adapter cable. Check the connections of the electrodes and leadwires.
ECG XX Lead Off	Low	B	The electrode has become detached from the animal or the lead wire has become disconnected from the adapter cable. Check the connections of the electrodes and leadwires.

Alarm message	Default priority	Indication on alarm reset	Cause and solution
ECG Signal Invalid	Low	A	Animal skin impedance is too high. Check ECG electrode application.
ECG Learning	Prompt	/	ECG learning is manually or automatically triggered.
Cannot Analyze QT	Prompt	/	/

Note: XX represents ECG lead name, for example RL, LL, V, Va, Vb, and so on.

D.2.3 Resp Technical Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
Resp Interference	Prompt	/	The respiration circuit is disturbed. Check for any possible sources of signal noise.
Electrode Poor Contact	Prompt	/	Check the electrode application. Reposition or replace the electrodes if necessary.

D.2.4 SpO₂ Technical Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
SpO2 Sensor Off	Low	B	The SpO ₂ sensor has become detached from the animal or the module. Check the sensor connection. If the alarm persists, replace the sensor.
SpO2 No Sensor	Low	A	The SpO ₂ extension cable is detached from the SpO ₂ module, or the SpO ₂ sensor is detached from the SpO ₂ extension cable. Check the SpO ₂ cable and the sensor connection. If the alarm persists, replace the sensor.
SpO2 Excess Light	Low	C	Ambient light is too strong. Move the sensor to a place with lower level of ambient light or cover the sensor to minimize the ambient light.
SpO2 No Pulse	Low	C	The SpO ₂ sensor failed to obtain pulse signal. Check the animal's condition and replace the sensor application site. If the alarm persists, replace the sensor.
SpO2 Sensor Incompatible	Low	C	Incompatible or an unspecified SpO ₂ sensor is used. Use specified sensors.
SpO2 Low Signal Quality	Low	C	1. Check the sensor and sensor position. 2. Make sure the animal is not shivering or moving. 3. The animal's pulse may be too low to be measured.
SpO2 Interference	Low	C	The SpO ₂ signal has been interfered. Check for any possible sources of signal noise and check the animal for excessive motion.
SpO2 Sensor Error	Low	C	Replace the sensor and measure again.
SpO2 Searching Pulse	Prompt	/	SpO ₂ is searching for pulse.

Alarm message	Default priority	Indication on alarm reset	Cause and solution
SpO ₂ Low Perfusion	Prompt	/	The SpO ₂ sensor is not properly placed or the animal's perfusion index is too low. 1. Check the sensor and sensor position. 2. Reposition the sensor if necessary.

D.2.5 Temp Technical Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
T XX Sensor Off	Low	A	Check the sensor connection and reconnect the sensor.

Note: XX represents a temperature site, for example skin, core, axil, T1, and so on.

D.2.6 NIBP Technical Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
NIBP Cuff Loose	Low	A	There is a leak in the cuff or air tubing. Use a cuff of correct type based on the animal size. Apply the cuff and connect the air tubing as instructed in the manual.
NIBP Cuff or Airway Leak	Low	A	Check the NIBP cuff and pump for leakages.
NIBP Airway Error	Low	A	The air tubing may be occluded. Check the air tubing for an occlusion or kinking. If the alarm persists, contact the Customer Service Department or your local distributor.
NIBP Weak Signal	Low	A	The animal's pulse is weak or the cuff is loose. Check the animal's condition and replace the cuff application site.
NIBP Overrange	Low	A	The measured NIBP value exceeds the module measurement range. Check the animal's condition.
NIBP Excessive Motion	Low	A	Check the animal's condition and reduce animal motion.
NIBP Cuff Overpressure	Low	A	The NIBP airway may be occluded. Check the airway and measure again. If the alarm persists, contact the Customer Service Department or your local distributor.
NIBP Timeout	Low	A	The measurement time out, and the BP value cannot be obtained. Check the animal's condition and NIBP connections, or replace the cuff and measure again.
NIBP Airway Leak	Low	A	Airway leakage is found during the NIBP leakage test. Check the NIBP cuff and pump for leakages.

D.2.7 IBP Technical Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
XX Sensor Error	Med	C	The IBP sensor fails. Replace the sensor.

Alarm message	Default priority	Indication on alarm reset	Cause and solution
XX No Sensor	Med	A	The IBP animal cable and/or corresponding IBP sensor is not connected or detached. Check the cable and sensor connection.
XX No Pulse	Low	A	The catheter may be occluded. Please flush the catheter.
XX Disconnected	High	C	The liquid way is disconnected from the animal, or the three-way valve is open to the air. Check the connection of the liquid way, or check the valve is open to the animal. If the alarm persists, contact the Customer Service Department or your local distributor.

Note: XX represents an IBP label, for example PA, CVP, FAP, P1, and so on.

D.2.8 C.O. Technical Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
TB Sensor Off	Low	A	Check the sensor connection and reconnect the sensor.
TI Sensor Off	Low	A	Check the sensor connection and reconnect the sensor.

D.2.9 CO₂ Technical Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
CO2 Module High Temp	Low	C	Ambient temperature is too high or there is a module failure. 1. Lower the operating temperature. 2. Restart the monitor. 3. If the alarm persists, the CO ₂ module may fail, contact the Customer Service Department or your local distributor.
CO2 Module Low Temp	Low	C	Ambient temperature is too low or there is a module failure. 1. Raise the operating temperature. 2. Restart the monitor. 3. If the alarm persists, the CO ₂ module may fail, contact the Customer Service Department or your local distributor.
CO2 Zero Failed	Low	C	For mainstream CO ₂ module, check the connections between the adapter and CO ₂ transducer. Wait till the sensor's temperature becomes stabilized, and then perform a zero calibration again. For sidestream CO ₂ module, restart the monitor. If the alarm persists, contact the Customer Service Department or your local distributor.
CO2 No Watertrap	Low	B	Check the water trap connections.

Alarm message	Default priority	Indication on alarm reset	Cause and solution
CO2 High Airway Pressure	Low	C	1. Check the airway pressure settings of the ventilator/anesthesia machine. 2. Disconnect the module from the ventilator/anesthesia machine. 3. Restart the monitor. 4. If the alarm persists, contact the Customer Service Department or your local distributor.
CO2 Low Airway Pressure	Low	C	1. Check the airway pressure settings of the ventilator/anesthesia machine. 2. Disconnect the monitor from the ventilator/anesthesia machine. 3. Restart the monitor. 4. If the alarm persists, contact the Customer Service Department or your local distributor.
High Barometric	Low	C	The ambient pressure exceeds the operating pressure range or CO₂ module fails. 1. Make sure that the ambient pressure meets the specifications, and check for sources that affect the ambient pressure. 2. Restart the monitor. 3. If the alarm persists, contact the Customer Service Department or your local distributor.
Low Barometric	Low	C	The ambient pressure exceeds the operating pressure range or CO₂ module fails. 1. Make sure that the ambient pressure meets the specifications, and check for sources that affect the ambient pressure. 2. Restart the monitor. 3. If the alarm persists, contact the Customer Service Department or your local distributor.
CO2 Airway Occluded	Low	C	1. Check if the sample line is kinked or occluded. 2. Replace the sample line. 3. Restart the monitor. 4. If the alarm persists, contact the Customer Service Department or your local distributor.
CO2 No Filterline	Low	A	Make sure that the filterline is connected.
CO2 Calibration Required	Low	C	Perform a calibration.
CO2 Airway Error	Low	C	1. Check if the sample line is kinked or occluded. 2. Replace the sample line. 3. Restart the monitor. 4. If the alarm persists, contact the Customer Service Department or your local distributor.
CO2 Adapter Error	Low	A	Check, clean or replace the airway adapter. Perform a zero calibration.
CO2 No Sensor	Low	A	Make sure that the CO ₂ transducer is connected.
CO2: Change Watertrap	Low	C	Replace the water trap.

D.2.10 Power Supply Technical Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
Low Battery	Med	C	Connect the monitor to the external power supply and allow the batteries to charge.

Alarm message	Default priority	Indication on alarm reset	Cause and solution
Critically Low Battery	High	C	Connect the monitor to the external power supply and allow the batteries to charge.
Power Board Comm Error	High	C	Restart the monitor. If the alarm persists, contact the Customer Service Department or your local distributor.
Battery Error	High	C	The battery may fail. Contact the Customer Service Department or your local distributor.
RT Clock Need Reset	High	C	Contact the Customer Service Department or your local distributor.
RT Clock Not Exist	High	C	Contact the Customer Service Department or your local distributor.
XX V Too High	High	C	There is a problem with the system power supply. Restart the monitor.
XX V Too Low	High	C	

Note: XX represents 2.5 V, 3.3 V, 5 V, or 12 V.

D.2.11 Recorder Technical Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
Recorder Init Error	Low	A	An error occurred during the recorder initialization. If the alarm persists, contact the Customer Service Department or your local distributor.
Recorder Comm Error	Low	A	Restart the monitor if not solved. If the alarm persists, contact the Customer Service Department or your local distributor.
Recorder Head Hot: Please Wait	Low	C	The recorder has been working for too long time. Stop the recording and resume the recording till the recorder's print head cools down.
Recorder Initializing	Prompt	/	Wait until the recorder initialization is completed.
Recorder Out Of Paper	Prompt	/	The recorder paper is not loaded or the recorder door is not closed. Check the recorder, load the recorder paper or close the recorder door.
Recorder Busy	Prompt	/	The buffer queue for recording is full.

D.2.12 Printer Technical Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
Printer Buffer Full	Prompt	/	The printer buffer is full. Wait till the printer finishes the printing task.
Fail	Prompt	/	The printer runs out of paper or cannot be connected. Check the printer.
Printing Stopped	Prompt	/	Printing is manually stopped.
Printer Unavailable	Prompt	/	The printer may fail. Check the printer.
PDF storage space is nearly full	Prompt	/	Delete the files saved under the PDF file path to release storage space. Otherwise you cannot save new PDF files.

Alarm message	Default priority	Indication on alarm reset	Cause and solution
Error storing PDF file	Prompt	/	The PDF file path settings on the printer server and the PDFCreator are not consistent or the PDF storage space is full. Check the PDF file path settings for consistency, or delete the files saved under the PDF file path to release storage space.
Change the print server language to be consistent with this monitor	Prompt	/	Verify that the language settings of the printer server and the monitor are consistent. Otherwise, you cannot perform printing.
Print Server Disconnected	Prompt	/	Check that the monitor is properly connected with the printer server.

D.2.13 Technical Alarm Messages Related to Networked Monitoring

Alarm message	Default priority	Indication on alarm reset	Cause and solution
CMS/eGW Disconnected	Low	B	The monitor is disconnected from the CMS. Check the network connection.
Viewed by Bed XX YY-ZZ, Network Disconnected.	Low	A	The network is interrupted when the monitor is viewed by another remote device. Check the network connection.
WLAN IP Address Conflict	Low	C	Wireless network IP network conflicts. Check the network settings.
LAN1 IP Address Conflict	Low	C	Wired network LAN1 IP network conflicts. Check the network settings.
Fail To Get WLAN IP Address	Low	C	Unable to automatically obtain the wireless network IP address. Check the network settings.
Fail To Get LAN1 IP Address	Low	C	Unable to automatically obtain the wired network LAN1 IP address. Check the network settings.

Note: XX refers to the department name, YY refers to the room number, and ZZ refers to the bed number.

D.2.14 Other Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
Storage Error	High	C	The storage card fails or files are damaged. Restart the monitor to format the storage card. If the alarm persists, contact the Customer Service Department or your local distributor.
Loading Default Config Failed	Low	A	The default configuration is not correctly loaded. The monitor will restore to the factory default configuration for the current species.
XX Measurement has been closed (XX refers to the module label)	Prompt	/	The parameter module is disabled. Switch on the module if you want to use it. For more information, see 4.3 <i>General Settings</i> .
The display setup for XX is disabled. (XX refers to the parameter label)	Prompt	/	The parameter of the newly inserted module is not displayed on the screen. Select a desired area to display the parameter numerics and waveforms. For more information, see 4.4.1 <i>Configuring the Normal Screen</i> .

Alarm message	Default priority	Indication on alarm reset	Cause and solution
The patient data storage space is nearly full. Please delete some discharged patients.	Med	B	Delete unnecessary earlier discharged animal.
User name or password error.	Prompt	/	The user name or password of logging in the cloud CMS is wrong. Please input the correct user name and password.
Account is invalid	Prompt	/	Both the user name and password of logging in the cloud CMS are correct. The remaining validity period of the user is 0. Contact Customer Service Department or your local distributor.

E Electrical Safety Inspection

The following electrical safety tests are recommended as part of a comprehensive preventive maintenance program. They are a proven means of detecting abnormalities that, if undetected, could prove dangerous to either the animal or the operator. Additional tests may be required according to local regulations.

All tests can be performed using commercially available safety analyzer test equipment. These procedures assume the use of a 601PROXL International Safety Analyzer or equivalent safety analyzer. Other popular testers complying with IEC 60601-1 used in Europe, such as Fluke, Metron, or Gerb, may require modifications to the procedure. Please follow the instructions of the analyzer manufacturer.

The electrical safety inspection should be periodically performed every two years. The safety analyzer also proves to be an excellent troubleshooting tool to detect abnormalities of line voltage and grounding, as well as total current loads.

E.1 Power Cord Plug

Test Item		Acceptance Criteria
The power plug	The power plug pins	No broken or bent pin. No discolored pins.
	The plug body	No physical damage to the plug body.
	The strain relief	No physical damage to the strain relief. No plug warmth for device in use.
	The power plug	No loose connections.
The power cord		No physical damage to the cord. No deterioration to the cord.
		For devices with detachable power cords, inspect the connection at the device.
		For devices with non-detachable power cords, inspect the strain relief at the device.

E.2 Device Enclosure and Accessories

E.2.1 Visual Inspection

Test Item	Acceptance Criteria
The enclosure and accessories	No physical damage to the enclosure and accessories.
	No physical damage to meters, switches, connectors, etc.
	No residue of fluid spillage (e.g., water, coffee, chemicals, etc.).
	No loose or missing parts (e.g., knobs, dials, terminals, etc.).

E.2.2 Contextual Inspection

Test Item	Acceptance Criteria
The enclosure and accessories	No unusual noises (e.g., a rattle inside the case).
	No unusual smells (e.g., burning or smoky smells, particularly from ventilation holes).
	No taped notes that may suggest device deficiencies or operator concerns.

E.3 Device Labeling

Check the labels provided by the manufacturer or the healthcare facilities are present and legible.

- Main unit label
- Integrated warning labels

E.4 Protective Earth Resistance

1. Plug the probes of the analyzer into the device's protective earth terminal and protective earth terminal of the AC power cord.
2. Test the earth resistance with a current of 25 A.
3. Verify the resistance is less than limits.

LIMITS

For all countries, $R = 0.2 \Omega$ Maximum

E.5 Earth Leakage Test

Run an Earth Leakage test on the device being tested before performing any other leakage tests.

The following outlet conditions apply when performing the Earth Leakage test:

- normal polarity (Normal Condition),
- reverse polarity (Normal Condition),
- normal polarity with open neutral (Single Fault Condition),
- reverse polarity with open neutral (Single Fault Condition)

LIMITS

For UL60601-1,

- ◆ 300 μA in Normal Condition
- ◆ 1000 μA in Single Fault Condition

For IEC60601-1,

- ◆ 500 μA in Normal Condition
- ◆ 1000 μA in Single Fault Condition

E.6 Animal Leakage Current

Animal leakage currents are measured between a selected applied part and mains earth. All measurements have a true RMS only

The following outlet conditions apply when performing the Animal Leakage Current test.

- normal polarity (Normal Condition);
- reverse polarity (Normal Condition),
- normal polarity with open neutral (Single Fault Condition);
- reverse polarity with open neutral (Single Fault Condition).
- normal polarity with open earth (Single Fault Condition);
- reverse polarity with open earth (Single Fault Condition).

LIMITS

For  CF applied parts

- ◆ 10 μA in Normal Condition
- ◆ 50 μA in Single Fault Condition

For  BF applied parts

- ◆ 100 μ A in Normal Condition
- ◆ 500 μ A in Single Fault Condition

E.7 Mains on Applied Part Leakage

The Mains on Applied Part test applies a test voltage, which is 110% of the mains voltage, through a limiting resistance, to selected applied part terminals. Current measurements are then taken between the selected applied part and earth. Measurements are taken with the test voltage (110% of mains) to applied parts in the normal and reverse polarity conditions

The following outlet conditions apply when performing the Mains on Applied Part test.

- Normal Polarity;
- Reversed Polarity

LIMITS

- ◆ For  CF applied parts: 50 μ A
- ◆ For  BF applied parts: 5000 μ A

E.8 Animal Auxiliary Current

Animal Auxiliary currents are measured between any selected Applied Part connector and the remaining Applied Part connectors. All measurements may have a true RMS only response.

The following outlet conditions apply when performing the Animal Auxiliary Current test.

- normal polarity (Normal Condition);
- reverse polarity (Normal Condition),
- normal polarity with open neutral (Single Fault Condition);
- reverse polarity with open neutral (Single Fault Condition).
- normal polarity with open earth (Single Fault Condition);
- reverse polarity with open earth (Single Fault Condition).

LIMITS

For  CF applied parts,

- ◆ 10 μ A in Normal Condition
- ◆ 50 μ A in Single Fault Condition

For  BF applied parts,

- ◆ 100 μ A in Normal Condition
- ◆ 500 μ A in Single Fault Condition

NOTE

-
- **Make sure the safety analyzer is authorized comply with requirement of IEC60601-1.**
 - **Follow the instructions of the analyzer manufacturer.**
-

F

Electronic Interface

The technical descriptions of the monitor, with a wireless or wired electronic interface, are as follows:

Electronic Interface	Specification
VGA	D-sub interface, complied with RS343 electrical standards.
Network connector	TCP/IP protocol bottom layer. HL7 protocol application layer. Calibration protocol of TCP/IP. RJ45 interface, supporting wired network 10 M/100 M, and complied with technical standard IEEE802.3. The intended information flow is from the equipment to the CMS or the server in the client site.
Wi-Fi	TCP/IP protocol bottom layer. HL7 protocol application layer. Calibration protocol of TCP/IP. The intended information flow is from the equipment to the CMS or the server in the client site.
USB	Type A interface, complied with USB 2.0 standard. Fixed time synchronization pulse specified by the USB protocol.
ECG	Mindray Animal Medical ECG connector
SpO2	Mindray Animal Medical SpO2 connector
NIBP	Mindray Animal Medical NIBP connector
Temp	Mindray Animal Medical Temp connector
IBP	Mindray Animal Medical IBP connector
C.O.	Mindray Animal Medical C.O. connector
Mainstream CO2	Mindray Animal Medical CO2 connector

G Units, Symbols and Abbreviations

G.1 Units

Abbreviation	In Full
μA	microampere
μV	microvolt
μs	microsecond
A	ampere
Ah	ampere hour
bpm	beat per minute
bps	bit per second
°C	centigrade
cc	cubic centimeter
cm	centimeter
dB	decibel
DS	dyne second
°F	Fahrenheit
g	gram
GHz	gigahertz
GTT	gutta
h	hour
Hz	hertz
in	inch
k	kilo
kg	kilogram
kPa	kilopascal
L	litre
lb	pound
m	meter
mAh	milliampere hour
Mb	mega byte
mcg	microgram
mEq	milli-equivalents
mg	milligram
min	minute
ml	milliliter
mm	millimeter

Abbreviation	In Full
mmHg	millimeters of mercury
cmH ₂ O	centimeters of water
ms	millisecond
mV	millivolt
mW	milliwatt
MΩ	megaohm
nm	nanometer
rpm	breaths per minute
s	second
V	volt
VA	volt ampere
Ω	ohm
W	watt

G.2 Symbols

Symbol	Explanation
–	minus
–	negative
%	percent
/	per; divide; or
~	to
+	plus
=	equal to
<	less than
>	greater than
≤	less than or equal to
≥	greater than or equal to
±	plus or minus
×	multiply
©	copyright

G.3 Abbreviations

Abbreviation	In Full
AaDO ₂	alveolar-arterial oxygen gradient
AC	alternating current
AHA	American Heart Association
Ao	aortic pressure
Art	arterial
ATMP	barometric pressure
awRR	airway respiratory rate
BSA	body surface area
BT	blood temperature
BTPS	body temperature and pressure, saturated
CaO ₂	arterial oxygen content
CCU	cardiac (coronary) care unit
CE	Conformité Européenne
C.I.	cardiac index
CIS	clinical information system
CISPR	International Special Committee on Radio Interference
CMS	central monitoring system
C.O.	cardiac output
CO ₂	carbon dioxide
COHb	carboxyhemoglobin
COPD	chronic obstructive pulmonary disease
CVP	central venous pressure
DC	direct current
Des	desflurane
Dia	diastolic
dpi	dot per inch
DVI	digital video interface
ECG	electrocardiograph
EDV	end-diastolic volume
EEC	European Economic Community
EMC	electromagnetic compatibility
EMI	electromagnetic interference
Enf	enflurane
ESU	electrosurgical unit
EtCO ₂	end-tidal carbon dioxide
EWS	Early Warning Score
FAP	femoral arterial pressure

Abbreviation	In Full
FCC	Federal Communication Commission
FDA	Food and Drug Administration
Fi	fraction of inspired
FiCO ₂	fraction of inspired carbon oxygen
GCS	Glasgow Coma Scale
GEDV	global end diastolic volume
GEDi	global end diastolic volume index
GEF	global ejection fraction
Hal	halothane
HIS	hospital information system
HR	heart rate
IABP	intra-aortic balloon pump
IBP	invasive blood pressure
ICU	intensive care unit
ID	identification
I:E	inspiratory time: expiratory time ratio
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronic Engineers
IP	internet protocol
IPS	individual parameter score
Iso	isoflurane
LA	left foreleg
LAP	left atrial pressure
LCD	liquid crystal display
LDAP	Lightweight Directory Access Protocol
LED	light emitting diode
LL	left hind leg
LVSW	left ventricular stroke work
LVSWI	left ventricular stroke work index
MAC	minimum alveolar concentration
MetHb	methemoglobin
MEWS	Modified Early Warning Score
MLDAP	Mindray Animal Medical LDAP, Mindray Animal Medical Lightweight Directory Access Protocol
MRI	magnetic resonance imaging
N/A	not applied
N ₂ O	nitrous oxide
NEWS	National Early Warning Score
NIBP	noninvasive blood pressure

Abbreviation	In Full
O ₂	oxygen
O ₂ %	oxygen concentration
OR	operating room
PA	pulmonary artery
PAWP	pulmonary artery wedge pressure
Pleth	plethysmogram
PPV	pulse pressure variation
PR	pulse rate
PVC	premature ventricular contraction
RA	right fore leg
RAP	right atrial pressure
Raw	airway resistance
Rec	record, recording
Resp	respiration
RL	right hind leg
RQ	respiratory quotient
RR	respiration rate
SEF	spectral edge frequency
Sev	sevoflurane
SI	stroke index
SlopeCO ₂	Slope of the alveolar plateau
SpO ₂	arterial oxygen saturation from pulse oximetry
SQI	signal quality index
SR	suppression ratio
SV	stroke volume
SVI	stroke volume index
SVR	systemic vascular resistance
SVRI	systemic vascular resistance index
Sync	synchronization
Sys	systolic pressure
TB	Blood Temperature
TD	temperature difference
Temp	temperature
TFC	thoracic fluid content
TI	injectate temperature
TP	total power
TV	tidal volume
UAP	umbilical arterial pressure
USB	universal serial bus

Abbreviation	In Full
UVP	umbilical venous pressure
VAC	volts alternating current
VO ₂	O ₂ consumption for one breath
VO ₂ I	oxygen consumption index

H Declaration of Conformity

Hereby, Shenzhen Mindray Animal Medical Technology Co., Ltd. declares that the radio equipment type Vetall 5 Veterinary Multi-Parameter Monitor is in compliance with Directive 2014/53/EU.

The full text of the declaration of conformity is available at the following internet address:

Site location	QR Code
https://ims.mindrayanimal.com/pub/detail.aspx?tid=14&rid=18529	

